DEPARTMENT OF TERRESTRIAL MAGNETISM
J. A. Fleming, Director

Scientific Results of Cruise VII of the CARNEGIE during 1928-1929
under Command of Captain J. P. Ault

OCEANOGRAPHY — I-A

Observations and Results in Physical Oceanography

H. U. SVERDRUP F. M. SOULE
J. A. FLEMING C. C. ENNIS

CARNEGIE INSTITUTION OF WASHINGTON PUBLICATION 545
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PREFACE

Of the 110,000 nautical miles planned for the seventh cruise of the nonmagnetic ship Carnegie of the Carnegie Institution of Washington, nearly one-half had been completed on her arrival at Apia, November 28, 1929. The extensive program of observation in terrestrial magnetism, terrestrial electricity, chemical oceanography, physical oceanography, marine biology, and marine meteorology was being carried out in virtually every detail. Practical techniques and instrumental appliances for oceanographic work on a sailing vessel had been most successfully developed by Captain J. P. Ault, master and chief of the scientific personnel, and his colleagues. The high standards established under the energetic and resourceful leadership of Dr. Louis A. Bauer and his co-workers were maintained, and the achievements which had marked the previous work of the Carnegie extended.

But this cruise was tragically the last of the seven great adventures represented by the world cruises of the vessel. Early in the afternoon of November 29, 1929, while she was in the harbor at Apia completing the storage of 2000 gallons of gasoline, there was an explosion as a result of which Captain Ault and cabin boy Anthony Kolar lost their lives, five officers and seamen were injured, and the vessel with all her equipment was destroyed.

In 376 days at sea nearly 45,000 nautical miles had been covered (see map, p. iv). In addition to the extensive magnetic and atmospheric-electric observations, a great number of data and marine collections had been obtained in the field of chemistry, physics, and biology, including bottom samples and depth determinations. These observations were made at 162 stations, at an average distance apart of 300 nautical miles. The distribution of these stations is shown in the map, which delineates also the course followed by the vessel from Washington, May 1, 1928, to Apia, November 28, 1929. At each station, salinities and temperatures were obtained at depths of 0, 5, 25, 50, 75, 100, 200, 300, 400, 500, 700, 1000, 1500, etc., meters, down to the bottom or to a maximum of 6000 meters, and complete physical and chemical determinations were made. Biological samples to the number of 1014 were obtained both by net and by pump, usually at 0, 50, and 100 meters. Numerous physical and chemical data were obtained at the surface. Sonic depths were determined at 1500 points and bottom samples were obtained at 87 points. Since, in accordance with the established policy of the Department of Terrestrial Magnetism, all observational data and materials were forwarded regularly to Washington from each port of call, the records of only one observation were lost with the ship, namely, a depth determination on the short leg between Pago Pago and Apia.

The compilations of, and reports on, the scientific results obtained during this last cruise of the Carnegie are being published under the classifications Physical Oceanography, Chemical Oceanography, Meteorology, and Biology, in a series numbered, under each subject, I, II, and III, etc.

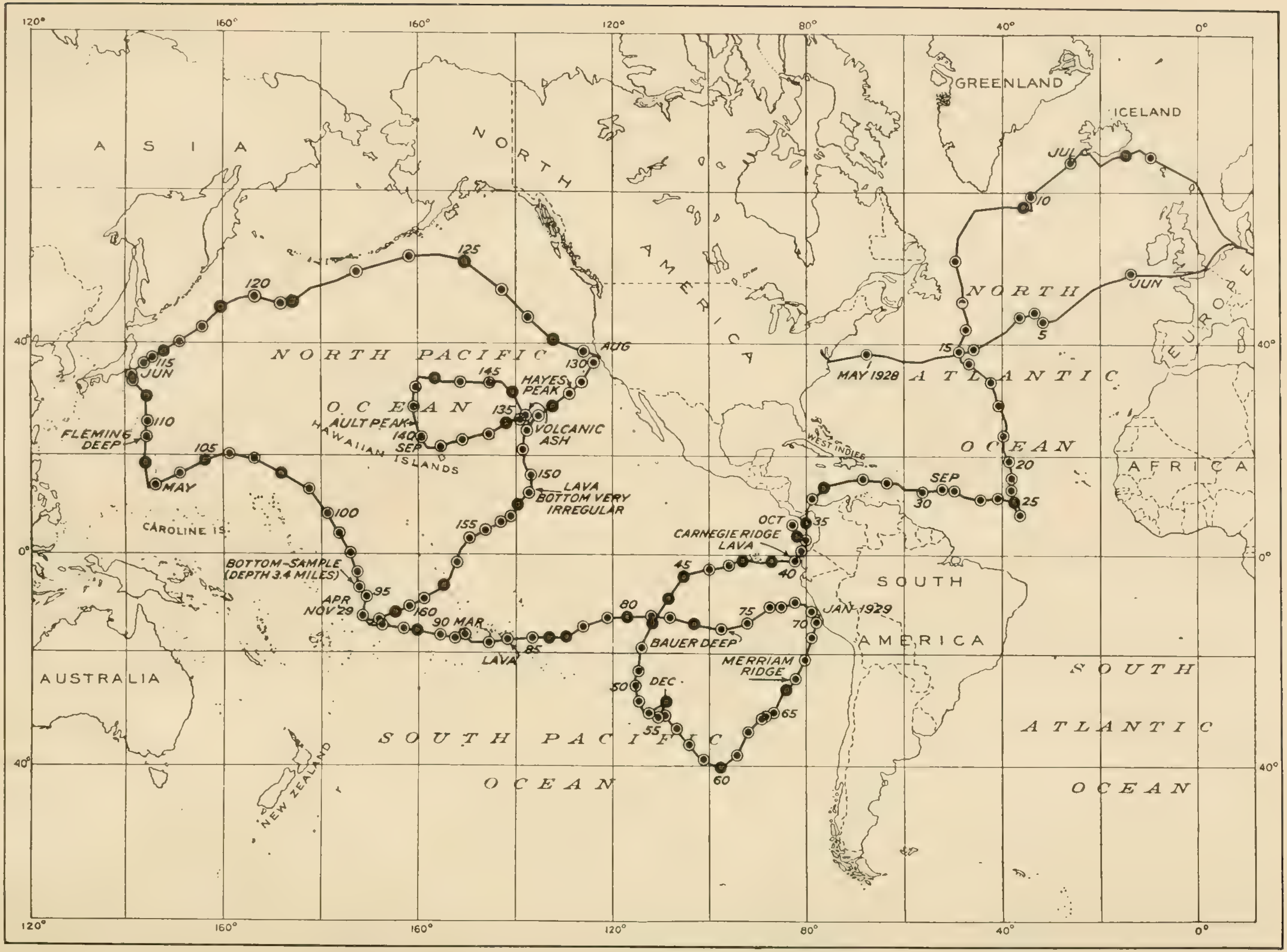
A general account of the expedition has been prepared and published by J. Harland Paul, ship's surgeon and observer, under the title The last cruise of the Carnegie, and contains a brief chapter on the previous cruises of the Carnegie, a description of the vessel and her equipment, and a full narrative of the cruise (Baltimore, Williams and Wilkins Company, 1932; xiii + 331 pages with 198 illustrations).

The preparations for, and the realization of, the program would have been impossible without the generous cooperation, expert advice, and contributions of special equipment and books received on all sides from interested organizations and investigators both in America and in Europe. Among these, the Carnegie Institution of Washington is indebted to the following: the United States Navy Department, including particularly its Hydrographic Office and Naval Research Laboratory; the Signal Corps and the Air Corps of the War Department; the National Museum, the Bureau of Fisheries, the Weather Bureau, the Coast Guard, and the Coast and Geodetic Survey; the Scripps Institution of Oceanography of the University of California; the Museum of Comparative Zoölogy of Harvard University; the School of Geography of Clark University; the American Radio Relay League; the Geophysical Institute, Bergen, Norway; the Marine Biological Association of the United Kingdom, Plymouth, England; the German Atlantic Expedition of the Meteor, Institut für Meereskunde, Berlin, Germany; the British Admiralty, London, England; the Carlsberg Laboratorium, Bureau International pour l'Exploration de la Mer, and Laboratoire Hydrographique, Copenhagen, Denmark; and many others. Dr. H. U. Sverdrup, now Director of the Scripps Institution of Oceanography of the University of California, at La Jolla, California, who was then a Research Associate of the Carnegie Institution of Washington at the Geophysical Institute at Bergen, Norway, was consulting oceanographer and physicist.

In summarizing an enterprise such as the magnetic, electric, and oceanographic surveys of the Carnegie and of her predecessor the Galilee, which covered a quarter of a century, and which required cooperative effort and unselfish interest on the part of many skilled scientists, it is impossible to allocate full and appropriate credit. Captain W. J. Peters laid the broad foundation of the work during the early cruises of both vessels, and Captain J. P. Ault, who had had the good fortune to serve under him, continued and developed that which Captain Peters had so well begun. The original plan of the work was envisioned by L. A. Bauer, the first Director of the Department of Terrestrial Magnetism, Carnegie Institution of Washington; the development of suitable methods and apparatus was the result of the painstaking efforts of his co-workers at Washington. Truly, as was stated by Captain Ault in an address during the commemorative exercises held on board the Carnegie in San Francisco, August 26, 1929, "The story of individual endeavor and enterprise, of invention and accomplishment, cannot be told."

Prior to the Carnegie observations on her last cruise, knowledge of the physical oceanography of the Pacific Ocean was unreliable, and in some parts entirely lacking. The Carnegie investigated many areas in which few, and sometimes no, observations had been made. Because of this, and because of the accuracy of the data gathered, the results presented in this volume are valuable.

Dr. H. U. Sverdrup, Director of the Scripps Institution of Oceanography, and F. M. Soule, of the Department of Terrestrial Magnetism, prepared the papers that comprise this volume. A considerable part of the work required in the reduction of the oceanographic observations was done by C. C. Ennis at the Department of Terrestrial Magnetism under the direction of Dr. J. A. Fleming, Director of the department. Mr. Ennis made a



OCEANOGRAPHIC STATIONS, CRUISE VII OF THE CARNEGIE, 1928-29

(At the 35 stations marked ● true sea-water samples were also obtained for salinity calibrations)

great number of the computations and prepared all the figures.

Sonic depth finding equipment loaned by the United States Navy Department made a program of sounding possible. Although the program changed occasionally with changing conditions, soundings were usually made every four hours. These soundings reveal changes that have to be made in our conceptions of the most probable course of the depth contours in the oceanic areas traversed.

Salinities were measured by the bridge and titration methods, and then compared. The results of the salinity work are given in table 2 and in the vertical distribution curves (Oceanography I-B, pp. 183-257, and 56-115).

Bottom samples were collected at the different stations with various samplers. These samples were sent to Washington for examination.

In his introduction Dr. Sverdrup states that oceanographic data accumulated after 1930 have not been considered by him in preparing the present volume, and this procedure has imposed certain limitations on the discussion. On the other hand, the Carnegie data have been freely placed at the disposal of every oceanographer who has needed them in his work, and have, therefore, been widely used and discussed from different points of view. Dr. Sverdrup has himself used them most extensively, particularly in other analyses of the waters and currents of the Pacific Ocean such as those appearing in "The oceans, their physics, chemistry, and general biology" by himself, Johnson, and Fleming. These later analyses have not materially changed the conclusions.

The present volume is the seventh in the series "Scientific results of cruise VII of the Carnegie under command of Captain J. P. Ault." It is the first of the Oceanographic Reports.

J. A. Fleming

Director, Department of Terrestrial Magnetism

GENERAL CONTENTS

OBSERVATIONS AND RESULTS IN PHYSICAL OCEANOGRAPHY

I

OBSERVATIONS IN PHYSICAL OCEANOGRAPHY

CONTENTS

WATER BOTTLES AND THERMOMETER FRAMES

The water bottles used on the Carnegie for the routine collection of water samples were of the Nansen type manufactured by Bergen Nautik. This type of bottle consists of a hollow brass cylinder equipped with valves, one in each end. The valves are operated synchronously by means of a connecting rod which is attached to the clamp that secures the bottle to the cable. When the bottle is sent down, this clamp is at the lower end of the bottle, the upper end being held to the cable by a pin. When the bottle is in this position the valves are open. The cable is paid out until the bottle reaches the level from which a sample is desired. Then a concentric cylindrical brass weight called a messenger is placed on the cable and released from the surface. The messenger slides down the cable to the bottle where it trips a trigger, pulls the holding pin and thus releases the upper end of the bottle from the cable. The bottle falls over and in so doing closes the valves in either end; the valves are locked in the closed position by a spring, and the desired sample is trapped in the bottle. Figure 1 shows a Nansen water bottle. Normally a series of several bottles are placed on the cable at intervals along its length for a single cast. In such a case a messenger is placed on the cable just below each bottle (except the lowest) and temporarily held in place by a short chain, the last link of which is attached to the bottle by means of a spring pin. After the surface messenger releases the upper end of the first bottle, it slides on down the cable to the lower end of the bottle where it releases the attached messenger which, in turn, continues down the cable. The process is repeated at each bottle. The bottle is also equipped with an air valve, a stopcock, and a removable frame suitable for holding two deep-sea reversing thermometers. For further description of the Nansen type water bottle see Helland-Hansen and Nansen (1926).

The Nansen bottles used on the Carnegie were tinned and the exterior painted white. Because of the absorption of dissolved oxygen by tinned brass (see Knudsen, 1923) the tabulated oxygen values are possibly somewhat too low but are comparable with all but the most recent observations in which silver lined collecting bottles have been used.

Large water bottles such as the Allen and Meteor types, described respectively by Allen (1927) and Wüst (1926), were used infrequently at shallow depths for the collection of microplankton.

An instrument which it was thought would be of great usefulness is a small light reversing water bottle for use on the bottom sampling line to obtain water samples and temperatures from the layers immediately above the bottom. (See fig. 2). Such bottles originally were manufactured by Bergen Nautik for the Carnegie but arrived on board just prior to the disaster and so were not tried out. They operated on the propeller principle described below in connection with thermometer reversing frames. Their capacity was 300 ccm and their weight 2.32 kg without thermometers.

Thermometer reversing frames, such as the one shown in figure 3, were used at the end of the bottom sampling piano wire attached to the drift line about 20 meters from the end. Equipped with a protected and with an unprotected thermometer, the arrangement was used to determine the depth at which bottom samples were taken, and at the same time it gave measurements of the temperature close to the bottom. The frame containing the thermometers was hinged off center and held in position by a threaded pin which was withdrawn by the action of a small propeller when the line was being hauled in. Experiments near the surface indicated that upward motion through the water over a distance of about 25 meters served to reverse the thermometers.

LITERATURE CITED

Allen, W. E. 1927. An improved closing bottle for subsurface sampling of fluids. Science, 65, pp. 66-67.

Helland-Hansen, B. and F. Nansen. 1926. The eastern North Atlantic. Geofys. Pub., 4, no. 2, p. 6.

Knudsen, M. 1923. Some new oceanographical instruments. Conseil Perm. Internat. Expl. Mer., Pub. Circ. no. 77, pp. 10-12.

Wüst, G. 1926. Bericht über die Ozeanographischen Untersuchungen. 2. Gesellsch. Erdk., Berlin, no. 1, p. 28.

FIG. 1

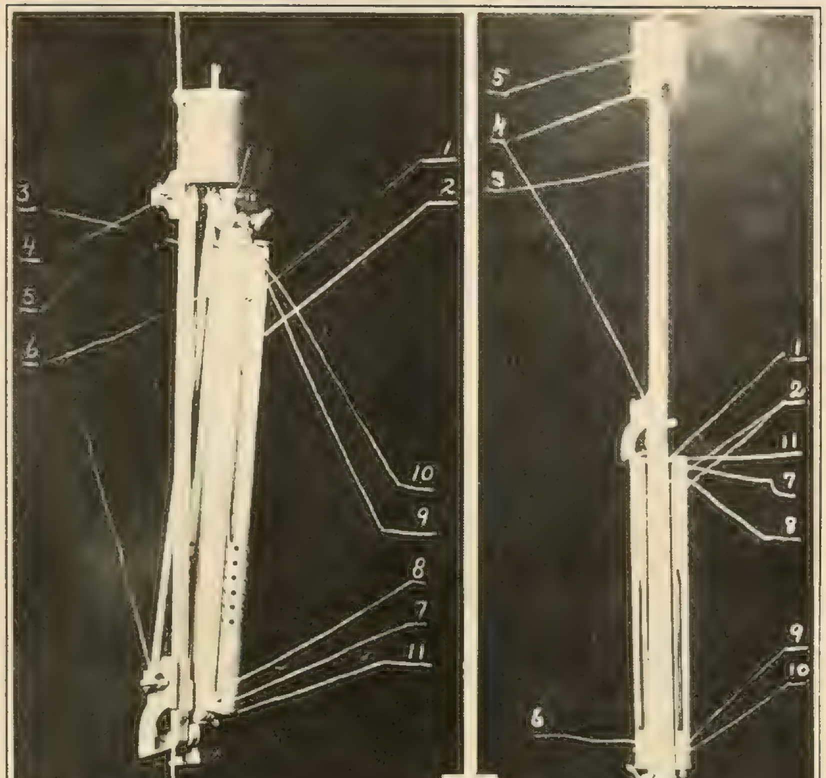


FIG. 2

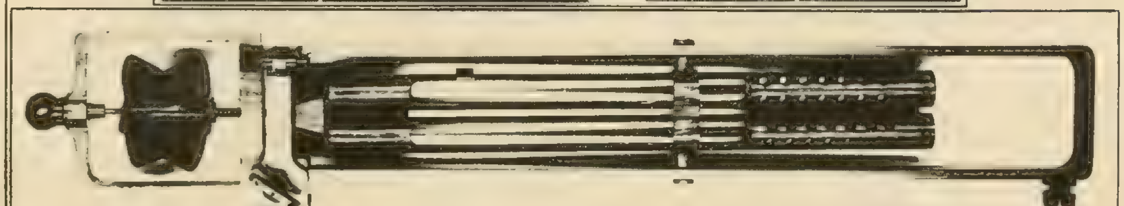


FIG. 3

FIG. 1—NANSEN WATER BOTTLE CLOSING
FIG. 2—PROPELLER OPERATED REVERSING WATER BOTTLE, OPEN AND CLOSED
FIG. 3—PROPELLER OPERATED THERMOMETER REVERSING FRAME

The surface temperature was recorded continuously by means of a sea-water thermograph. The instrument and its operation are described in the volume dealing with the meteorological data, and tables showing hourly values of sea-surface temperatures are given in that volume and in table 1 of Oceanography I-B. In the following, therefore, we are concerned with the subsurface temperatures only.

The subsurface temperatures were determined by means of protected reversing thermometers of the well-known pattern manufactured by Richter and Wiese.[1] All thermometers had been examined at the Physikalische Technische Reichsanstalt (PTR) and will be referred to by the PTR numbers. The corrections determined by the Reichsanstalt will be designated the "PTR corrections." Table 1 gives the range for each thermometer, the character of graduation, the date of the PTR certificate, and the numbers of the stations at which used.

From the footnotes in table 1 it is seen that a number of the thermometers were lost because of accidental breaking of cable during the occupation of several stations. The remaining thermometers were all lost when the *Carnegie* was destroyed. No determinations of the corrections of the thermometers were undertaken at sea and, since all thermometers were lost, a re-examination is impossible. A large number of protected thermometers were used in pairs, however, and from the differences between the corrected readings of two such thermometers it is possible to arrive at several conclusions as to the accuracy of the observed temperatures, assuming the PTR corrections to have remained unchanged.

Before entering on an examination of these differences, the possible errors of the temperature observations will be briefly discussed. Some of the thermometers were divided to one-twentieth degree and others to one-tenth. The errors of these two classes of thermometers, which for sake of brevity will be referred to as the one-twentieth and the one-tenth thermometers, will be treated separately. The following sources of error then have to be considered: (1) errors of reading; (2) correction errors arising from (*a*) reduction errors, (*b*) limit of accuracy of the test, and (*c*) change of zero point; and (3) errors of breaking-off device.

(1) Errors of reading. All thermometers were read to 0°.01 and reading was always made by means of a special reading lens. The accuracy of the reading, therefore, can safely be assumed to lie within the limits ±0°.01. Böhnecke (1927) states regarding the one-twentieth thermometers that the errors of reading for such thermometers when read to 0°.001 never exceed 0°.005 and as a rule were smaller than 0°.003 according to the experience at the Reichsanstalt.

(2*a*) Correction errors arising from reduction errors. A correction, as is well known, must be applied to the reversing-thermometer reading, since as a rule it is read at a temperature differing from the temperature at which the column of mercury broke off. The exact formula for this correction is

$$(T + v_0)\,(T - t)/6100 \qquad (1)$$

where T is the temperature at which the thermometer was reversed, v_0 is the volume of the mercury at zero degree, t is the temperature at which the thermometer was read, and 6100 is a constant depending on the quality of the glass. The temperature at which the thermometer was reversed, however, is unknown and in the first approximation this temperature, T, may be replaced by the reading of the thermometer T'. As a second approximation, T' may be replaced by $(T' + dT')$, where dT' is equal to the correction which is computed by means of formula (1), using T' instead of T. The final formula for the second approximation to the correction will thus be

$$[(T' + v_0)\,(T' - t)/6100]\,[1 + (T' + v_0) + (T' - t)/6100] \qquad (2)$$

This formula has been derived by Schumacher (1923) and represents an improvement of formula (1) commonly used. He shows that in extreme cases it may be necessary to apply still another approximation in order to reduce the reduction error beyond the values of the errors of reading, but in the case of the *Carnegie* observations the errors in the correction, K, as computed by means of formula (2) never exceeded 0°.002 and therefore may be disregarded. A practical method of determining the correction has been described by Soule (1933).

(2*b*) Correction errors arising from limit of accuracy of the test. The corrections of the thermometers which were communicated by the PTR and which must be applied in addition to the reduction correction, K, have been rounded to 0°.01. The corrections may be regarded as exact within 0°.005 at the time when the thermometers were tested; however, the corrections are likely to change with time and, according to the experience of the *Meteor* expedition, this change has the character of a parallel displacement of the correction curve supposing the breaking-off device always to function properly Wüst (1928). The parallel displacement of the correction curve may be attributed to a change of the zero point of the thermometer.

(2*c*) Correction errors arising from change of zero point. A change of the zero point of the thermometer takes place as a rule some time after the manufacture of the thermometer and in most cases may be ascribed to a contraction of the bulb which causes a rise of the zero point and thus a decrease in the correction which has to be applied at 0°. The contraction of the bulb is hastened by artificial aging of the thermometers but the process usually continues for a long time afterward at a slower and slower rate. During the *Meteor* expedition Böhnecke examined the zero points of the greater number of the thermometers of the expedition at intervals of about two months. From this examination it appears that the zero point as a rule rose during the first two to six months after the manufacture and that no appreciable changes took place later. In several instances a lowering of the zero point occurred before the subsequent rise, this type of change being characteristic of instruments of very recent manufacture. In a few instances the variations were irregular evidently because of bad functioning of the break-off device. These thermometers were easily recognized when used together with a perfect thermometer because the differences in the indications would vary irregularly within considerable limits. Only in two cases were great variations of the zero point observed (0°.6

[1] For detailed description see Wissensch. Ergebn. d. Deut. Atlantischen Exped. auf dem Forschungs- und Vermessungsschiff *Meteor* 1925-27, vol. 4, pt. 1. (1932).

Table 1. Thermometers used on the Carnegie, cruise VII

Fabr. no.	PTR no.	Date of PTR cert.	Graduation	Range	Used at stations
		1927	°	° °	
1604	127552	Oct 31	1/10	-1 - 30	1-162
1605[a]	127553	31	1/10	-1 - 30	1- 31
1606[a]	127554	31	1/10	-1 - 30	1- 31
1607[a]	127555	31	1/10	-1 - 30	1- 31
1608[a]	127556	31	1/10	-1 - 30	1- 31
1609	127557	31	1/10	-1 - 30	1-162
1610	127558	31	1/10	-1 - 30	1-162
1611	127559	31	1/10	-1 - 30	18-150
1621	127075	Nov 9	1/10	9 - 30	1-162
1622	127076	9	1/10	9 - 30	1-162
1623	127077	9	1/10	9 - 30	1-110
1624	127078	9	1/10	9 - 30	1-162
1625	127079	9	1/10	9 - 30	1-110
1626	127080	9	1/10	9 - 30	2-117
1627	127081	9	1/10	9 - 30	1-162
1628	127082	9	1/10	9 - 30	1-162
1629	127083	9	1/10	9 - 30	1-162
1630	127084	9	1/10	9 - 30	1-151
1631	127085	9	1/10	9 - 30	1-162
1632	127086	9	1/10	9 - 30	1-162
1633	127087	9	1/10	9 - 30	4-162
1634	127088	9	1/10	9 - 30	2-162
1635	127089	9	1/10	9 - 30	2-162
1641	127584	30	1/20	3 - 13	8-162
1642	127585	30	1/20	3 - 13	7-162
1643[b]	127586	30	1/20	3 - 13	7-151
1644	127587	30	1/20	3 - 13	7-156
1645	127588	30	1/20	3 - 13	7-152
1646[a]	127589	30	1/20	3 - 13	8- 30
1647[a]	127590	30	1/20	3 - 13	8- 30
1648	127591	30	1/20	3 - 13	....
1649[a]	127592	30	1/20	3 - 13	17- 31
1650[a]	127593	30	1/20	3 - 13	7- 31
		1928			
1658[b]	502	Jan 3	1/20	-2 - 8	33-150
1659	503	3	1/20	-2 - 8	33-162
1660[b]	504	3	1/20	-2 - 8	30-150
1661[a]	505	3	1/20	-2 - 8	1-131
1662[b]	506	3	1/20	-2 - 8	46-150
1663[a]	507	3	1/20	-2 - 8	1- 31
1664[a]	508	3	1/20	-2 - 8	1- 31
1665[c]	509	3	1/20	-2 - 8	11- 49
1666[a]	510	3	1/20	-2 - 8	1- 31
1667[a]	511	3	1/20	-2 - 8	3- 31
1668[a]	512	3	1/20	-2 - 8	11- 30
1669[a]	513	3	1/20	-2 - 8	11- 30
1670	514	3	1/20	-2 - 8	3-162
1671	515	3	1/20	-2 - 8	51-165
1672[a]	516	3	1/20	-2 - 8	1- 31
1930	3376	Oct 18	1/20	3 - 13	81-162
1931	3377	18	1/20	3 - 13	81-153
1932	3378	18	1/20	3 - 13	72-162
1933[d]	3379	18	1/20	3 - 13	81-154
1973	4246	Dec 6	1/10	9 - 30	113-162
1978	4251	6	1/10	9 - 30	113-162
1979	4252	6	1/10	9 - 30	113-162
1985[d]	4258	6	1/10	9 - 30	154-155
1879	4259	6	1/20	3 - 13	113-162
1912	4260	6	1/20	-2 - 8	....
		1929			
2094	158	Mar 6	1/20	-2 - 9	33-162
2095[b]	159	6	1/20	-2 - 9	115-150
2096[e]	160	6	1/20	-2 - 9	113-142
2097[b]	161	6	1/20	-2 - 9	116-150
2098[b]	162	6	1/20	-2 - 9	116-150
2099[b]	163	6	1/20	-2 - 8	116-150
2100	197	15	1/10	-2 - 30	116-162
2101	198	15	1/10	-2 - 30	116-162

Table 1. Thermometers used on the Carnegie, cruise VII--Continued

Fabr. no.	PTR no.	Date of PTR cert.	Graduation	Range	Used at stations
		1929	°	° °	
2102	199	Mar 15	1/10	-2 - 30	118-162
2103[b]	200	15	1/10	-2 - 30	118-150
2104[b]	201	15	1/10	-2 - 30	118-150
2105	202	15	1/10	-2 - 30	118-162
2106[b]	203	15	1/10	-2 - 30	118-150
2108	205	15	1/10	-2 - 30	119-162
2109	206	15	1/10	-2 - 30	119-162
2060	264	Apr 12	1/20	-2 - 9	130-132
2243[b]	908	Aug 3	1/20	-2 - 9	131-150
2244[b]	909	3	1/10	-2 - 30	142-150
108	37339		1/10	-5 - 16	50-109
151	40661		1/10	9.5 - 30	32
48040	67955		1/10	-2 - 26	22- 28
48066	67958		1/10	-2 - 26	37- 87
1285	88700		1/10	10 - 35	17- 21
1336[a]	93687		1/10	-2 - 29	17- 31
1338	93699		1/10	-2 - 29	37- 39
1339	93690		1/10	-2 - 29	29-112

[a]Lost at station 32. [b]Lost at station 151. [c]Lost at station 49. [d]Lost at station 156. [e]Lost at station 144.

and 0.°8), perhaps owing to the opening of a bubble in the glass. Böhnecke states that the amplitude of the change of the zero point amounts on the average in the case of the one-twentieth thermometers to 0.°015 and in case of the one-tenth thermometers to 0.°02, the corresponding maximum values being 0.°035 and 0.°08. In this connection it may be mentioned that the corrections at zero scale division of the fifteen reversing thermometers used on the Maud expedition were determined at the Reichsanstalt in 1909, 1910, or 1914. The redeterminations made in 1922 to 1924 showed these corrections had remained unchanged in eight cases, had increased by 0.°01 in two cases, had decreased by 0.°01 in four cases, and by 0.°03 in one case, the mean change being -0.°003 and the maximum -0.°03. These results cannot be compared with the results of the Meteor expedition because the small changes of the Maud thermometers may be ascribed to the circumstance that the PTR calibration had taken place a considerable time after the completion of the thermometers by the manufacturer. In the case of the Carnegie thermometers, the possibility exists that the changes in the zero point may reach the amounts which Böhnecke found for the Meteor thermometers. Any considerable change of the zero point of one thermometer, however, can be detected if this thermometer had been used together with others and examinations of the differences between thermometers which were used in pairs should give valuable information. On the basis of experience on the Meteor it must be expected furthermore that thermometers received in 1929 would show slightly lower temperatures that those received in 1928, because it must be assumed that the zero point has risen more for the older thermometers. It must also be expected that the temperatures based on the original PTR corrections on the whole will be slightly too high because of the rise of the zero point but the mean error due to this circumstance will hardly exceed 0.°02.

(3) Errors of the breaking-off device. The errors arising from this source can be examined by repeating with the shortest possible interval of time the determination of the zero point of the thermometer or by comparisons between a perfect and an imperfect thermometer. The number of thermometers which do not function properly, according to Böhnecke's experience, is very small and the errors are seldom greater than ± 0°.02. The possible errors are probably somewhat greater for the one-tenth thermometers and the limits are estimated to be ± 0°.03. It happens, however, that the imperfect thermometers behave erratically and give readings which must be rejected because they are obviously wrong. Even a thermometer which as a rule functions reliably may for unknown reasons give erroneous results, but such cases ordinarily can be detected, expecially if two thermometers have been attached to the same water bottle.

The preceding discussion can be summarized as follows:

Source of error	Thermometer graduated to 1/20°		Thermometer graduated to 1/10°	
	Probable error	Maximum error	Probable error	Maximum error
	°	°	°	°
(1) Reading	±0.003	±0.005	±0.005	±0.01
(2a) Reduction	0.000	±0.002	0.000	±0.002
(2b) Limited accuracy of test	±0.003	±0.005	±0.003	±0.005
(2c) Change of zero point	-0.015	+0.02 to -0.035	-0.02	+0.02 to -0.08
(3) Breaking-off device	0.000	±0.02	0.000	±0.03

The probable error of a single temperature determination by means of a one-twentieth thermometer not again examined after the PTR test, according to this compilation, lies between the limits -0°.009 and -0°.021, and the possible errors lie between the limits 0°.052 and -0.067. The corresponding limits in the case of a thermometer which is graduated to 0°.1 are -0°.012 to -0°.026 and 0°.067 to -0°.127, respectively. These limits are only approximate and especially the maximum errors must be regarded as roughly estimated and probably too great, but they furnish a basis for a discussion of the possible differences between the indications of two thermometers used simultaneously.

The differences between the indications of two thermometers which have been used together can be ascribed to the same sources as the errors of one single thermometer and we can, therefore, discuss these differences in the same sequence.

(1) Differences owing to errors of reading. Taking account of the maximum errors as stated in the preceding paragraph, these differences may reach ±0°.01 and ±0°.02 respectively, but are, as a rule, considerably smaller than ±0°.01 and disappear when averaging many comparisons.

(2a) Differences arising from reduction errors. These differences are always negligible because the possible reduction errors, which are smaller than 0°.002, have the same sign for both thermometers.

(2b) Differences owing to errors arising from limit of accuracy of the test. These differences are systematic for a given pair of thermometers but cannot exceed ±0°.01.

(2c) Differences owing to change of zero point. The differences owing to changes of the zero point may reach appreciable values because it is not probable that the zero points of two thermometers change in the same amount although the changes may have the same sign for both thermometers. The difference has a systematic character and is not eliminated when forming the mean value from many comparisons. If two thermometers are compared during a long period, it is to be expected that the difference will change in the course of time because it is not probable that the changes of the zero points of the two thermometers are at the same rate. Furthermore it must be expected that a new thermometer will give slightly lower temperatures than an old thermometer because the zero point of the older thermometer has risen more. The differences owing to change of zero point, according to the experiences of Dr. Böhnecke, may amount to 0°.055 for the one-twentieth thermometers and to 0°.10 for the one-tenth thermometers. The sign of the difference depends only on whether the indication of the thermometer giving the lowest reading is subtracted from the others or vice versa.

(3) Differences arising from errors of the breaking-off device. These differences may amount to ±0°.04 or ±0°.06 respectively but as a rule they are insignificant because most of the thermometers function perfectly. The differences are not systematic and therefore do not influence the mean value of the difference.

The results of this discussion are summarized below:

Source of difference	Thermometer divided to 1/20°		Thermometer divided to 1/10°	
	Probable	Maximum	Probable	Maximum
(1) Reading	±0.005	±0.01	±0.01	±0.02
(2a) Reduction	0.000	0.000	0.000	0.000
(2b) Limited accuracy of test	0.003	0.01	0.003	0.01
(2c) Change of zero point	0.015	0.055	0.020	0.10
(3) Breaking-off device	0.000	±0.04	0.000	±0.06

From this compilation it appears that for one comparison the probable difference between two thermometers which both are divided to 1/20° is 0°.023 and on the average for a number of comparisons it is 0°.013 because the errors of reading cancel. In order to find the range over which the differences may be distributed we have to take into account the maximum differences which may result from errors of reading and errors of the breaking-off device, considering that the errors due to limited accuracy of test and from change in zero point are systematic. Assuming these differences to be negative we find the limits -0°.068 to +0°.032, and assuming the difference to be positive we find the limits -0°.032 to +0°.068, and in both cases a range of 0°.100. This range is reduced to 0°.020 if the breaking-off device functions perfectly. The maximum value of the difference at one single comparison is 0°.115 and the maximum average value of many comparisons is 0°.066 with a range of 0°.100 as before. In case of the thermometers which are

divided to 1/10° we find a probable difference of 0°.033 at one single comparison and a probable average difference of 0°.023, the maximum range of the differences being 0°.160 or 0°.040 if the breaking-off device functions perfectly. The corresponding maximum values are 0°.190 and 0°.110 with a range of 0°.160. From this discussion it appears that a study of the differences between the corrected readings of thermometers, which have been used in pairs, will help to clarify the question about the probable and possible errors of the single temperature observations.

Table 2 contains the results of the comparisons between thermometers which were divided to 1/20°. Here the reduced reading of the thermometer with the highest PTR number has been subtracted from the reduced

Table 2. Comparisons between thermometers which were divided to one-twentieth of a degree

PTR nos.	No. of comparisons	Mean difference	Range	Used at stations
		°	°	
127584-127585	4	-0.024	0.014	152-157
127585-127586	35	0.006	0.045	7- 60
127585-3378	38	0.005	0.031	72-114
127585-161	16	-0.004	0.026	116-134
127586-503	29	-0.025	0.016	78-114
127586-514	10	-0.017	0.041	61- 77
127586-3376	3	0.006	0.021	121-126
127586-909	5	-0.015	0.010	142-149
127587-127588	5	0.004	0.010	7- 13
127589-127590	7	-0.005	0.022	8- 30
127592-127593	10	-0.017	0.019	17- 31
127593-514	7	-0.004	0.030	7- 14
502-503	21	-0.003	0.017	32- 52
502-504	38	0.004	0.049	53- 91
505-508	19	-0.002	0.024	3- 31
507-510	20	0.012	0.039	3- 31
512-513	7	0.008	0.038	11- 30
3376-3379	4	0.006	0.030	81- 91
3376-3378	2	0.003	0.012	116-118
3378-3379	2	-0.014	0.009	152-153
158-159	15	-0.003	0.025	115-132
161-908	10	0.050	0.016	140-150

reading of the thermometer with the lowest PTR number. The signs of the differences are, therefore, accidental and on the average for all thermometers the difference ought to disappear. The table also gives the number of comparisons for the different pairs, the average difference, the range of the differences, and the number of stations at which the thermometers were used together. The last-named information is not complete inasmuch as only the first and last stations at which thermometers were used have been entered.

Table 3 contains the corresponding information for the cases in which one of the thermometers was divided to 1/20° and the other to 1/10°, and table 4 for the cases in which both thermometers were divided to 1/10°. It should be noted that a total of thirty-six cases has been omitted when preparing these tables because the differences were so great that one of the thermometers obviously was out of order.

From these tables it is seen that the mean difference reaches or exceeds the value of 0°.03 in three cases only. The difference (161-908) is 0°.05 and this difference must be attributed to an error in the correction of thermometer 908 because 161 was used in combination with 127585 and 203, and was found in agreement with these. In order to bring thermometer 908 in agreement with the others we must change the correction of this thermometer by +0°.05. This has been done in the final revision of the temperatures. The other conspicuous

Table 3. Comparisons between thermometers which were divided to one-twentieth or one-tenth of a degree

PTR nos.	No. of comparisons	Mean difference	Range	Used at stations
		°	°	
127552-127584	50	0.020	0.053	92-151
127552-514	10	-0.005	0.032	152-162
127557-502	26	-0.012	0.036	92-119
127558-127584	1	0.015	....	158
127077-127587	6	0.005	0.013	36- 46
127585-37339	9	0.016	0.031	61- 71
502-200	15	0.013	0.056	133-150
503-198	11	0.015	0.031	152-162
3376-205	11	0.013	0.041	153-162
3378-203	6	0.005	0.021	121-126
3379-4258	1	0.015	....	154
3379-4259	6	0.004	0.026	121-126
159-201	17	0.001	0.035	133-150
161-203	3	0.003	0.017	136-139
37339-514	2	-0.042	0.031	59- 60

Table 4. Comparisons between thermometers which were divided to one-tenth of a degree

PTR nos.	No. of comparisons	Mean difference	Range	Used at stations
		°	°	
127552-127557	91	0.010	0.050	1- 91
127554-127556	29	-0.004	0.040	1- 31
127555-127558	3	0.007	0.060	1- 2
127558-127075	4	-0.002	0.010	3- 6
127558-198	37	0.009	0.070	116-151
127559-127076	20	-0.008	0.044	40- 60
127559-127087	7	-0.001	0.032	20- 36
127559-67958	3	0.023	0.028	37- 39
127075-127076	34	-0.027	0.065	127-162
127076-127077	31	0.011	0.066	1- 34
127076-127078	53	0.013	0.064	61-115
127077-127079	29	0.000	0.069	74-110
127077-37339	6	0.030	0.024	51- 58
127078-127079	24	-0.008	0.066	1- 32
127078-127089	11	-0.015	0.044	152-162
127080-127086	9	0.008	0.030	105-117
127081-127082	126	0.007	0.067	1-162
127083-127084	22	-0.014	0.060	1- 30
127084-127088	38	0.017	0.058	33- 70
127084-127088	48	-0.008	0.055	71-117
127085-127086	30	-0.024	0.063	1- 43
127085-127086	98	0.007	0.061	44-162
127087-127089	46	0.008	0.083	44-118
127087-127088	27	-0.001	0.034	136-162
127087-203	6	0.005	0.040	127-135
127088-127089	23	-0.001	0.031	2- 32
127089-206	4	0.006	0.019	148-151
4251-4252	16	-0.008	0.045	113-162
199-206	25	0.003	0.033	121-147
200-201	14	0.000	0.037	118-132
202-203	3	-0.028	0.051	118-120
202-205	29	0.003	0.066	121-151
202-4259	10	-0.004	0.048	152-162
205-206	2	0.012	0.005	119-120

differences are: (37339-514) = -0.°041 and (37339-127077) = -0.°30. The first of these differences, -0.°041, cannot be given any great weight because it is based on two comparisons only. In these combinations thermometer 37339 is an old thermometer which was examined at PTR in 1910 and re-examined in 1918 and 1922 to 1924. On these three occasions the same correction at zero was found. It should be expected, therefore, that 37339 gives correct temperatures. The results may be interpreted to mean that the two new thermometers, 514 and 127077, gave temperatures too high. Thermometer 37339 was used in combination with a third new thermometer and the difference had the same sign also in this case, namely, (339-127585) = -0.°016. Considering that we should expect the zero point of the new thermometer to rise, it is indeed probable that these gave temperatures which were slightly too high when corrected by means of the original PTR values and that the corrections of the three thermometers 127077, 514, and 127585 actually should be lowered by about 0.°02 or 0.°03. Another old thermometer, 67958, was used in combination with one of the new thermometers and the difference was of the same sign as above, being (67958-127559) = -0.°023. The correction of thermometer 127559 should thus, perhaps, be lowered by 0.°02. We have no possibility of estimating the possible changes in all the other thermometers, however, and it therefore seems inadvisable to introduce any changes in these isolated cases, especially since the mean differences always are based on less than ten comparisons and therefore are uncertain. Instead of changing the original PTR correction we shall estimate, on the basis of the differences in tables 2, 3, and 4, the possible errors which are introduced by retaining the PTR corrections.

When discussing the probable differences between two one-twentieth thermometers, it was found that this difference, as a rule, is not greater than 0.°013. From table 2 it is seen that, omitting 908, the difference is smaller than 0.°013 in fifteen of twenty-one cases and that the greatest observed difference is 0.°025. The differences in the change of zero point, thus, have not exceeded 0.°025. The absolute change for each thermometer is unknown, but on the average this change has probably amounted to -0.°015. Considering that it is not probable that two thermometers have been combined which have both changed appreciably, we can safely state that the systematic error of the single thermometers, as a rule, is smaller than 0.°02 and never greater than 0.°03.

The ranges over which the differences are distributed give an idea of the errors of reading and of the breaking-off device and thus an idea of the error of one single temperature determination. The maximum range was estimated to 0.°100 and in case the breaking-off device always functioned perfectly we should expect the range to remain smaller than 0.°020. We find that the range is smaller than 0.°020 in eight of twenty-one cases, the maximum range being 0.°049. We therefore may conclude that the errors of reading and of the breaking-off device never exceeded 0.°03 and, since the range is smaller than 0.°031 in sixteen of twenty-two cases, that the errors as a rule were smaller than 0.°015. The error of one single temperature determination by means of these theremometers, therefore, is smaller generally than 0.°035, ranging from -0.°005 to -0.°035, and the error is in no case greater than ±0.°06.

Turning next to the thermometers which are divided to 1/10° we find no greater scattering of the mean differences than in case of the one-twentieth thermometers The probable mean difference between the one-tenth thermometers was estimated to 0.°023 and the maximum difference to 0.°160. We find a difference which is smaller than 0.023 in twenty-nine of thirty-four cases, and a maximum difference of 0.°030. Since the expected average change of the zero point for these thermometers is -0.°02, we may safely state that the systematic error of one single thermometer, as a rule, is smaller than 0.°025 and never exceeds 0.°035. The ranges of the differences are, as a rule, greater for these thermometers than for the one-twentieth thermometers as should be expected because both the errors of reading and of the breaking-off device inevitably are greater. The maximum range was estimated to 0.°160 and in case the breaking-off device functioned perfectly, to 0.°040. We find that the range is smaller than 0.°040 in twelve of thirty-three cases and never greater than 0.°083. The errors due to reading and breaking-off may, therefore, reach 0.°05 but, as a rule, are considerably smaller than 0.°02. Thus the total error of one single temperature determination is, as a rule, smaller than 0.°045 and never greater than 0.°085.

These conclusions are supported by an examination of the cases in which a one-twentieth thermometer was used simultaneously with a one-tenth thermometer. The mean differences are of the same order as before and do not exceed 0.°020, omitting thermometer 37339. The ranges usually are greater than for the one-twentieth thermometers but smaller than for the one-tenth thermometers. If we subtract the corrected readings of the one-twentieth thermometers from the corrected readings of the one-tenth thermometers, we find a positive difference in three and a negative difference in ten cases, omitting thermometer 37339. The unweighted mean difference is -0.°0035. From this result it appears that the corrections of the one-tenth thermometers have not changed more than the corrections of the one-twentieth thermometers. Since the corrected readings of the latter are slightly higher, the zero point of these thermometers seems to have risen more than the zero point of the one-tenth thermometers. It should thus be safe to assume that the zero point of the one-tenth thermometers has, as a rule, not risen more than 0.°025 and never more than 0.°035.

When discussing the possible differences, attention was drawn to the circumstance that the differences between the two thermometers which were compared during a long period should be expected to change, because the changes of the zero points of the two thermometers could not be assumed to follow each other. From table 4 it is seen that the differences between thermometers 127084 and 127088 and thermometers 127085 and 127086 have changed considerably, but the changes are in all other cases small. A noteworthy change in the difference, therefore, seldom occurs. It was also mentioned that older thermometers probably would give slightly higher temperatures than more recently made thermometers because the zero point of the former had risen more. The cases in which a new thermometer was used together with an older one are compiled in table 5. A "new thermometer" is defined as one tested at PTR less than eight months before its use and an "old thermometer" is defined as one tested at least twelve months earlier than a new one. The values given are differences obtained by subtracting the reading of the new thermometer from that of the old one. It is seen

Table 5. Comparisons between thermometers which were used during July, September, October, and November, 1929, and had been calibrated either during October, November, 1927, or January, 1928 (old thermometers) or during March or August, 1929 (new thermometers)

Old minus new thermometer PTR no.	No. of comparisons	Mean difference	Range
		°	°
127558-198	37	0.009	0.070
127087-203	6	0.005	0.040
127089-206	4	0.006	0.019
127585-161	16	-0.004	0.026
127586-909	5	-0.015	0.010
502-200	15	0.013	0.056
503-198	11	0.015	0.031
Weighted mean		0.009	

that the differences are positive in five of the seven cases, the mean weighted difference being 0.009. The old thermometers thus give slightly higher temperatures than the new ones, as should be expected. The conclusions which were drawn from the results of Dr. Böhnecke's examination of similar thermometers are thus confirmed.

The final conclusion of this discussion is that most of the thermometers give temperatures which are systematically too high, but that the errors are as a rule smaller than 0°02 and in no case greater than 0°035. A single temperature observation may be affected also by accidental errors, which, as a rule are considerably smaller than 0°02 and in the case of the one-twentieth thermometers never greater than 0°03 nor more than 0°04 in the case of the one-tenth thermometers. These accidental errors could not have been avoided but the systematic errors could have been reduced had it been possible to re-examine the thermometers after their use. The systematic errors, however, are so small that in most cases they are of no significance.

This conclusion is verified by an examination of the temperatures at great depth at stations in the Peruvian basin. Stations 68 to 79 are all located in this basin in which the water at great depths appears to be very uniform, since it is not in direct communication with water in adjacent areas. The observations from this region show that this is true because the same temperature is found at all stations below a depth of 2700 meters. The agreement between the individual observations is good as evident from the compilation in table 6.

Table 6. Temperature observations below a level of 2700 meters in the Peruvian basin

Station no.	Depth in meters	Thermometer no.	Temperature centigrade
69	2781	127502	1.83
	2781	127504	1.83
	3188	127506	1.81
70	2907	127558	1.82
	3333	127502	1.83
	3333	127504	1.83
	3760	127506	1.84
71	2963	127506	1.81
72	2781	127558	1.82
	3189	127502	1.82
	3189	127504	1.82
	3603	127506	1.84
74	2897	127558	1.84
	3313	127502	1.83
	3313	127504	1.82
	3735	127506	1.81
76	3181	127502	1.84
	3181	127504	1.83
77	2721	127506	1.84
78	2803	127502	1.82
	2803	127504	1.82
	3138	127506	1.82

From the data in table 6 we find the following mean values:

Thermometer nos.	127558	127502	127504	127506
Mean temperature, °C	1.827	1.828	1.825	1.824

and none of the individual values deviate as much as 0°02 from these mean values. There is, thus, an excellent agreement between the four thermometers in question and the error of the individual observations appears to be well within the limits which were stated above.

LITERATURE CITED

Böhnecke, G. 1927. Veröff. Inst. Meeresk., A, no. 17, p. 6.

Schumacher, A. 1923. Ann. Hydrog., vol. 51, pp. 273-280.

Soule, F. M. 1933. Hydrog. Rev., vol. 10, pp. 126-130, May.

Wüst, G. 1928. Ztschr. Gesellsch. Erdk., Erganzungsheft 3, pp. 66-83.

The thermometric method for determining depths in the sea has recently been discussed by Dr. A. Schumacher (1923) and part of this discussion will be repeated here for the sake of completeness. An unprotected thermometer which is subjected to a certain pressure will show a fictitious temperature which can be regarded as consisting of the actual temperature of the surroundings plus the effect of the compressibility of the glass. On account of this pressure effect the reading of the thermometer will be higher than the reading corresponding to the temperature of the surroundings and the increase of the reading per unit increase of pressure can be determined in laboratory. The difference between the indications of two thermometers, one protected against pressure and one unprotected, which both are subjected to the same pressure in the same surroundings, can on the other hand be used for determining the pressure, assuming the pressure coefficient of the unprotected thermometer to be known. This method is used in oceanographic work. Two thermometers, one protected and one unprotected, are attached to the same water bottle and the pressure at which the thermometers were reversed can be computed from the corrected readings. Knowing the average density of the water from the surface and down to the level where the thermometers were reversed, the depth can be found. Since the pressure coefficient of the thermometers is given in degree centigrade per kg/cm^2 of increase in pressure and since the pressure of 10 meters of water of density 1 is equal to 1 kg/cm^2, we get:

$$D = \frac{10\,\Delta t}{q \cdot \rho_m} \qquad (1)$$

where D means the depth in meters, Δ the difference between the corrected readings of the two thermometers, q the pressure coefficient of the unprotected thermometer, and ρ_m the mean density from the surface to the level at which the thermometers were reversed.

The corrections which must be applied to the reading of the protected reversing thermometer have already been discussed. The correction to be applied to the reading of the unprotected thermometer because it was read off at a temperature which differs from the temperature at which it was reversed, is found by means of the same formula:

$$K = \frac{(T_u + v_o)\,(Tp - t)}{6100} \qquad (2)$$

where T_u means the "temperature" of the unprotected thermometer v_o the volume of mercury at zero degrees expressed in degrees, Tp the temperature at which the thermometer was reversed, t the temperature at which it was read off and where 6100 is a constant which depends on the quality of the glass. The temperature at which the thermometer was reversed is known exactly from the indication of the protected thermometer, but the indication of the unprotected thermometer at reversal is not known. As a first approximation the reading of the unprotected thermometer, T_u' is introduced in equation (2) instead of T_u. This introduction leads in the case of the Carnegie observations to errors which never exceed 0°005 and may be regarded as negligible. The correction on account of the thermometer being read at a temperature which differs from the temperature at reversal has, therefore, been computed by means of the formula:

$$K = \frac{(Tu' + v_o)\,(Tp - t)}{6100} \qquad (3)$$

To the correction K the scale correction at the temperature of reading has to be added. Practical methods of determining this correction and of determining the depth have been described by Ennis (1933) and Soule (1933).

After these remarks about the corrections of the unprotected thermometers, we can turn to a discussion of the accuracy of the depth as determined by means of pressure thermometers (equation 1). Following the procedure of Schumacher, we compute the inaccuracy in the depth which would result from inaccuracy in the quantities Δt, q, and ρ_m:

1) $dD = \frac{10}{q\,\rho_m} d\Delta t$ error in D arising from an error dΔt in Δt

2) $dD = \frac{10\Delta t}{q^2\,\rho_m} dq$ error in D arising from an error dq in q

3) $dD = -\frac{10\Delta t}{q\,\rho_m^2} d\rho_m$ error in D arising from an error $d\rho_m$ in ρ

1. The pressure coefficient for the Carnegie thermometer values was between 0.07 and 0.09. For the mean density we may introduce 1.035. The factor $\frac{10}{q\,\rho m}$ lies, therefore, between the limits 138 and 107 and an error in the temperature difference of 0.01 introduces, therefore, an error of 1.4 to 1.1 meter. The error of the difference depends on the accuracy of the two thermometers. We have already discussed the accuracy of the protected reversing thermometers and have arrived at the conclusion that the error of one single temperature determination is, as a rule, considerably smaller than ±0.04 and never greater than ±0.075. As to the errors of the unprotected thermometers, we assume, since these have a more narrow division of the scale, that the errors may be twice as great--that means generally smaller than ±0.08 and never greater than ±0.15. The error in the difference between the corrected readings of a protected and an unprotected thermometer will therefore as a rule be considerably smaller than ±0.12 and never greater than ±0.225. The error in depth arising from these errors will usually be considerably smaller than ±16 and never greater than ±31 meters.

2. The pressure factor q, was determined at the Physikkalische-Technische Reichsanstalt, Charlottenberg, and entered on the certificate of the thermometer to the fourth decimal place. Assuming the last decimal place to be correct (which means the error in the factor q to be smaller than 0.005), we find, taking ρ_m as a constant and equal to 1.035:

Maximum error in D	Temperature difference			
	10	20	30	40
q = 0.07	1	2	3	4
q = 0.09	1	1	2	2

The errors in depth introduced by the uncertainty in q appear thus to be small but it has to be considered that the pressure coefficient is not quite independent of the temperature and that it also may change in course of time, and the possible errors, therefore, are two or three times as great as those which are stated above.

3. The mean density of the water from the surface and to the level where the thermometers were reversed is easily determined with an accuracy of 0.0005. Assuming the mean value of the density to be constant and equal to 1.035 we find:

Maximum error in D	Temperature difference			
	10	20	30	40
q = 0.07	1	1	2	3
q = 0.09	1	1	2	2

The errors which are introduced on account of uncertainty as to the density are thus always small.

Summing up the results of this discussion, considering that a temperature difference of 10° roughly corresponds to a depth of 1250 meters, we find that the errors in the depth as determined by means of unprotected and protected thermometers probably lie within a limit

Depth in meters	Maximum error probably within
1000	±20
2000	±21
3000	±24
4000	±28
5000	±32

The errors of the thermometers enter here with the greatest weight.

In his discussion of the "Meteor" data, Wüst (1932) has shown that errors due to errors of coefficient q increase more with increasing depth than supposed here, but simultaneously he assumes the errors due to errors of reading to be smaller. His estimate of the greatest possible total error gives, therefore, smaller values at small depths, but greater values at great depths. He obtains, for instance, the values ±14 meters and ±49 meters at 1000 and 5000 meters, respectively, whereas our estimates are ±20 meters and ±32 meters. His final conclusion is that at depth below 1000 meters the mean accuracy of the thermometric determination of depth is from 0.6 to 0.4 per cent, whereas our final results, after discussion of the actual values, gives mean accuracy of about 1 per cent at 1000 meters and 0.5 per cent below 3000 meters.

In order to test this result, the cases have been examined in which the wire angle was equal to 5° or smaller. In these cases the wire length gives an accurate value of the depth and a comparison with the depths obtained by means of pressure thermometers furnishes data for an estimate of the possible errors in the thermometric determination of the depth. The cases in which the wire angle was from 6° to 10° were also studied as the depth corresponds closely to the wire length even when the angle is 10°. If the wire angle remained equal to 10° from the surface and down to the greatest depth, a wire length of 1000 meters would correspond to a depth of 985 meters, but as a rule the wire is curved and the difference between the wire length and the depth is smaller.

Table 1 contains the results of the comparisons between the depths as obtained by thermometers and the

Table 1. Differences between wire lengths and thermometer depths

PTR no.	Wire angle 0° to 5°				Wire angle 6° to 10°			
	No. of observations	Mean depth, meters	Mean difference, meters	Total range, meters	No. of observations	Mean depth, meters	Mean difference, meters	Total range, meters
838	6	365	- 0.5	14	6[a]	372	- 1.7	13
865	4[b]	145	- 3.0	10	3[a]	158	- 6.3	13
866	0[b]	......	....	...	4	608	6.0	21
868	2	2215	4.5	7	2	2898	23.5	5
869	2	1241	- 3.0	4	2	1237	8.5	19
990	...	......	....	...	1[b]	51	3.0	...
1688	...	......	....	...	1	51	6.0	...
1689	7	160	- 2.3	5	7	87	- 3.0	5
1690	16	409	- 2.4	21	12[b]	282	- 1.6	9
1691	11	193	- 2.7	10	6	274	- 0.5	6
1692	2	530	- 2.0	6	3[b]	174	0.3	13
1693	15	818	- 5.3	17	15	516	- 2.5	24
1694	...	......	....	...	1[b]	203	- 1.0	...
1695	18	257	- 2.1	13	16[a]	259	- 0.6	11
1696	8	2561	-20.9	37	14	2810	-13.1	45
1698	1	3072	-13.0	...	1	939	2.0	...
1699	1	4075	1.0	...	3	1283	10.3	31
1701	2	1645	9.0	22	2	199	- 7.0	4
1702	1	1021	0.0	...	1	547	8.0	...
1703	1	2042	0.0	...	2	1070	10.5	25
2993	2	3211	-23.0	18	2	3924	- 0.5	1
2994	2	1049	2.0	12	12	1123	10.0	19
2995	3	1104	0.0	16	9[b]	648	- 0.6	18
2996	5	1565	11.6	17	12	2005	14.9	35

[a]Two cases omitted. [b]One case omitted.

Table 2. Number of cases where the difference lies between stated limits

Wire angle	Interval of difference: wire length minus thermometer depth in meters				
	0 to 5.0	5.1 to 10.0	10.1 to 15.0	15.1 to 20	20.1 to 25.0
0 to 5	14	2	2	0	2
6 to 10	12	7	4	0	1

wire length for the different pressure thermometers. The table gives the number of the thermometer, the number of observations with this thermometer, the mean difference between the wire length and thermometer depth, the total range of these differences, and the mean depth as obtained by thermometers. These data are entered for wire angles 0° to 5° and 6° to 10°.

An inspection of the table shows that the differences in depth between the wire lengths and thermometer depths as a rule are smaller than 5 meters if the wire angle is from 0° to 5° and smaller than 10 meters if the wire angle is from 6° to 10° (see table 2).

Only in three instances the mean difference is so great that an error in either the correction of the thermometers or the pressure factor seems to have influenced the mean difference. This applies to thermometers 1696, 2993, and 2996. According to an inspection of the single values it seems probable that the corrections of these thermometers have changed since they were determined at PTR and, since an error in the temperature correction introduces an error which is independent of depth, the simplest procedure is to apply a constant correction to the depths which are computed on the basis of the original temperature corrections. For the depths derived by means of these thermometers the following corrections have, therefore, been adopted:

Depth by thermometer 1696: correction: -20 meters;
Depth by thermometer 2993: correction: -10 meters;
Depth by thermometer 2996: correction: +10 meters.

After application of these corrections we find the following mean differences:

Wire angle 0° to 5°. Wire length minus thermometer depth: -1.9 meters (109 cases).
Wire angle 6° to 10°. Wire length minus thermometer depth: +3.2 meters (137 cases).

It is seen that the mean thermometer depth is slightly greater than the mean wire length in case the wire angle is between 0° and 5°. This result may be owing to systematic errors in the corrections of the thermometer (a greater rise of the zero point of the unprotected thermometers than of the protected thermometers would introduce an error of this sign) or it may be owing to a small systematic error of the meter wheel, used for measuring the wire length. It is of greater interest to state that the difference increases when the wire angle increases as should be expected.

Examining the total ranges of the differences we find that these are much smaller than the possible ranges which were estimated on the basis of the sources of errors. We found that these errors might lead to errors in the depth between +20 and -20 meters for depths smaller than 1000 meters, which means that the range of the differences between the exact values and the measured values of the depth might amount to 40 meters. At greater depths this range would be greater. When comparing the thermometer depth with wire length we have furthermore to bear in mind that the reading of the meter wheel may not indicate the exact wire length because the wire may have slipped on the wheel and we must, therefore, expect the ranges in table 1 to be greater than the estimated ranges (p. 12) provided that the errors of the thermometers are as great as supposed. From table 1, however, we find:

Table 3. Number of cases in which the total range of the difference, wire length minus thermometer depth, lies between stated limits

Wire angle	Limits of range in meters		
	0 to 20	21 to 40	41 to 60
0 to 5	13	3	0
6 to 10	13	5	1

From this compilation it is seen that the ranges are smaller than estimated, and this result leads to the conclusion that the accuracy of the temperature determinations is greater than supposed.

Grouping the differences and ranges according to the depths to which the thermometers have been used, we find the values which are entered in table 4.

Table 4. Differences between wire length and thermometer depth, and total ranges of these differences

Mean depth	Number of thermometers	Number of observations	Mean difference in meters	Maximum range
Wire angle 0° to 5°				
0 to 1000	8	79	- 2.4	21
1000 to 2000	6	15	1.6	22
> 2000	6	15	- 2.4	37
Wire angle 6° to 10°				
0 to 1000	16	88	- 1.1	24
1000 to 2000	4	19	9.9	31
> 2000	4	30	11.4	45

From this table it is seen that the difference is independent of depth if the wire angle is from 0° to 5° but the range of the differences increases with depth as was expected. If the wire angle is from 6° to 10° the difference increases with increasing wire length in agreement with the fact that the thermometer depth, if exactly determined, must be smaller than the wire length and the difference must increase with depth. In this case we find also that the maximum range increases with depth but the maximum ranges are greater than in case of the wire angle from 0° to 5°. The last result is easily accounted for by the fact that the curvature of the wire enters as an uncertain element if the wire angle is appreciable.

On the basis of the preceding discussion the accuracy of the thermometric determination of depth on board the Carnegie can be stated, assuming that the thermometers have functioned properly. Extrapolating to 6000 meters we find:

Depth	1000	2000	3000	4000	5000	6000
Accuracy of thermometric determination of depth in meters	±10	±12	±15	±20	±25	±30

This accuracy is highly satisfactory. It is evident that every uncertainty as to the depth, arising because of great wire angle, can be eliminated by attaching pressure thermometers to some of the water bottles along the wire.

LITERATURE CITED

Ennis, C. C. 1933. Hydrog. Rev., vol. 10, pp. 131-135. May.

Schumacher, A. 1923. Ann. Hydrog., vol. 51, pp. 273-280.

Soule, F. M. 1933. Hydrog. Rev., vol. 10, pp. 126-130. May.

Wüst, G. 1932. Wissensch. Ergebn. d. Deut. Atlantischen Exped. auf dem Forschungs- und Vermessungschiff "Meteor," 1925-1927, vol. 4, Erster Teil, pp. 60-177.

DETERMINATION OF DEPTHS AT WHICH TEMPERATURES WERE MEASURED AND WATER SAMPLES COLLECTED

The length of the wire from the surface to the water bottle gives the exact depth only if conditions are so favorable that the wire remains vertical but if the drift of the vessel is great on account of surface currents or wind, or if considerable subsurface currents occur, the wire cannot be kept in a vertical position. An approximate value of the depth of a water bottle can then be computed from the length of the wire to the bottle and the wire angle at the surface, assuming the latter to remain constant. Such computation will generally render erroneous values for the depth, however, because the wire will, as a rule, not remain straight but will form a curve and the wire angle is, therefore, not constant but varies with depth. In most cases the wire angle decreases with depth and the assumption of a constant wire angle gives, therefore, too small values of the depth.

The Carnegie could not be manuevered so readily that the wire could be kept approximately vertical under all conditions and great wire angles necessarily occurred. The knowledge of the depth at which temperatures were measured and from which water samples were brought up would, therefore, in many instances have been inaccurate if this should have been derived from wire lengths and wire angles only. On board the Carnegie, however, every second water bottle of the deep series was provided with one unprotected and one protected thermometer, and by means of the indications of these thermometers the depths of these water bottles could be found with an accuracy, which, according to the results in a preceding section (p. 11) was about ±10 meters at a depth of 1000 meters and ±30 meters at a depth of 6000 meters. Knowing the depth of several points of the wire with this accuracy, the curvature of the wire could be determined and the depth of the intermediate water bottles could be found. When taking the shallow series, down to 300 to 400 meters, two or more of the water bottles were also provided with unprotected thermometers and the indications of these were used for detecting any conspicuous deviation of the wire from a straight line. It was found, however, that at small depths no great errors were introduced by assuming the wire angle to remain constant.

The practical method, which was adopted for computing the depths on the basis of all available information, is best explained by means of an example. Table 1 contains the data from Carnegie station 71 (latitude 11° 57′ south, longitude 78° 37′ west). At this station, which was occupied on February 6, 1929, two series of water bottles were sent down. The wire angles observed on board are entered in the first column of the table and were 35° for the shallow and 40° for the deep series. The cosines of these angles are entered in the second column of the table. The third column contains the wire lengths to the different water bottles. Four of the seven water bottles of the deep series and two of the water bottles of the shallow series were provided with both protected and unprotected thermometers. From the indications of these thermometers, the depths have been computed which are entered in the fourth column of the table. The next column contains the factors by means of which the corresponding wire lengths must be multiplied in order to give these depths. These factors and the cosines of the wire angles have been plotted against wire lengths (fig. 1) and curves have been drawn representing the factors by means of which any wire length has to be multiplied in order to find the depth of that particular point on the wire. From the curves the factors have been read off for the intermediate wire lengths and entered in the fifth column of the table. The final depths in column six have been derived by multiplying the wire lengths (column three) with these factors.

From table 1 it is seen that the ratio between the

Table 1. Computation of depths at Carnegie station 71 (latitude 11° 57′ south, longitude 78° 37′ west, February 6, 1929) on the basis of thermometer depths and assuming the wire angle to be constant

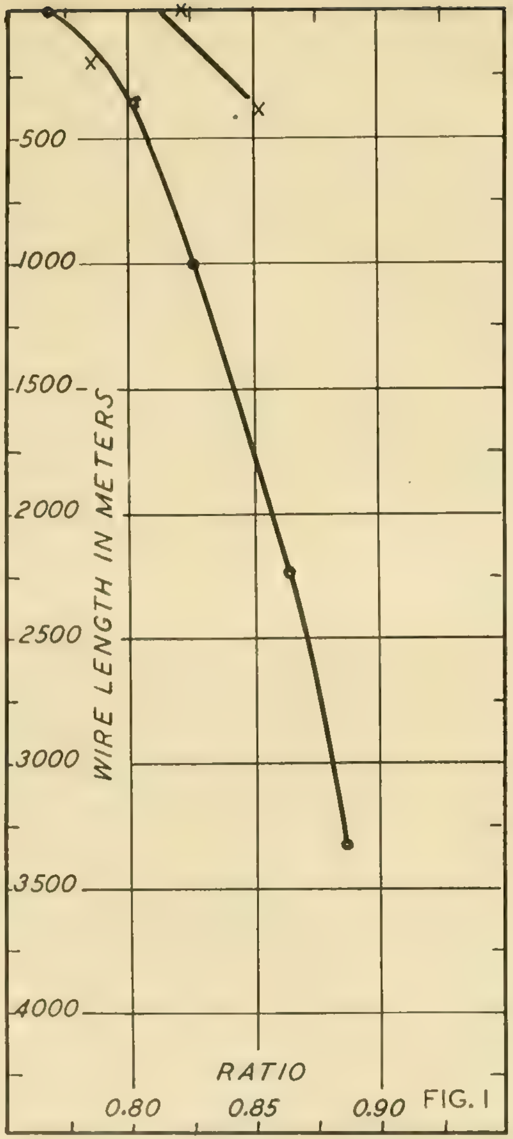
1	2	3	4	5	6	7	8	9	10
Wire angle, °	Cosine of wire angle	Wire length, meters	Thermometer depths, meters	Ratio	Adopted ratio	Adopted depth, meters	Depth wire angle constant, meters	Observed temperature, °C	Observed salinities, ‰
35	0.819	0	......	....	....	0	0	23.46	35.24
		5	......	....	0.810	4	4	23.30	35.26
		24	......	....	0.812	19	20	23.30	35.24
		49	......	....	0.814	40	40	18.15	35.14
		73	......	....	0.818	60	60	15.85	35.09
		98	......	....	0.820	80	80	14.30	35.02
		200	157	0.785	0.832	166	164	12.91	34.94
		295	......	....	0.842	248	242	11.76	34.87
		391	333	0.852	0.850	332	320	10.74	34.79
40	0.766	369	296	0.802	0.800	295	283	11.42	34.85
		628	......	....	0.811	509	481	8.16	34.64
		1016	838	0.825	0.825	838	778	5.29	34.54
		1652	......	....	0.847	1399	1265	3.15	34.62
		2250	1941	0.863	0.863	1941	1724	2.23	34.64
		2797	......	....	0.875	2447	2142	1.87	34.67
		3345	2963	0.886	0.886	2963	2562	1.81	34.68

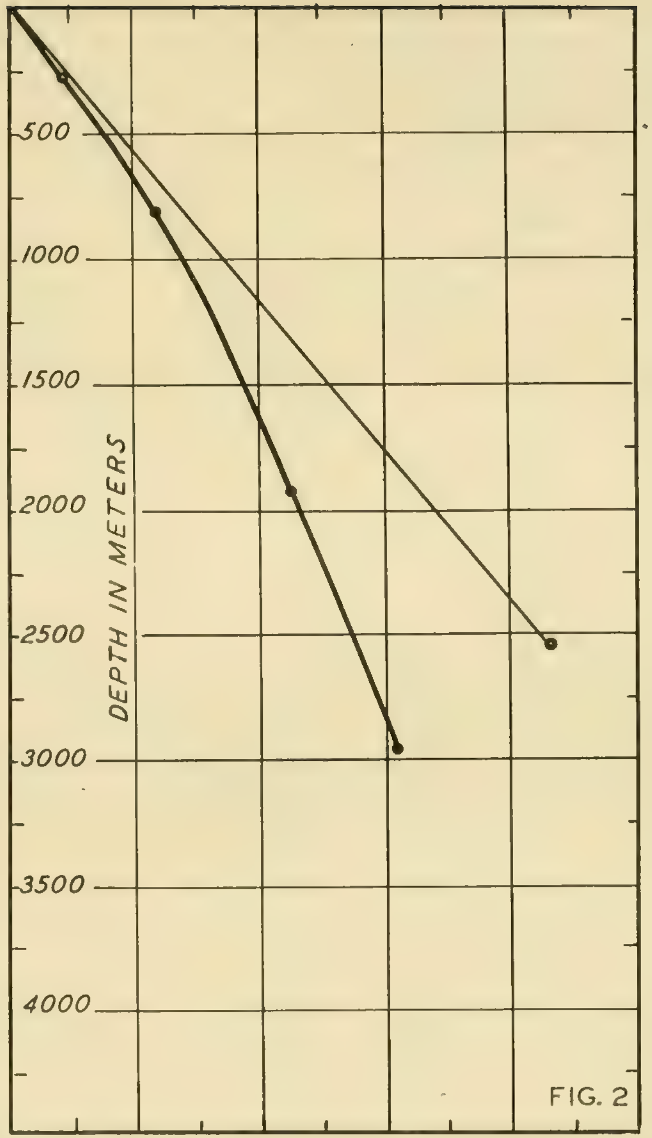
wire length and the depth increases from the surface and down, meaning that the wire angle decreases. By means of the wire lengths and the actual depths of the different points on the wire, the curve which the wire formed at the time when the water bottles were reversed has been constructed and represented graphically in figure 2.

The straight line which is entered in figure 2 shows the position which the wire would have had if the wire angle had remained constant. It is seen that the actual depth of any given point on the wire is considerably greater than the depth corresponding to a constant wire angle. This fact is also evident from column 8 in table 1. This gives the depths which are derived by means of thermometer depths and wire length and the depths which are computed on the basis of a constant wire angle. In the table the observed temperatures and salinities have been entered. According to the values in the table, the temperatures and salinities were observed at greater depths than those which are obtained when assuming the wire angle to be constant. The discrepancy increases with depth and reaches an amount of 400 meters at a depth of about 2900 meters. Representing graphically the vertical distribution of the temperature, the temperature curve is displaced upward if the depths are derived from wire lengths and wire angle only. This example can be used for illustrating the importance of accuracy as to depth even when the vertical variation of the temperature in vertical direction is small. Station 71 is situated within an area where the temperatures are very uniform below 1800 meters. In figure 3 the temperatures at stations 68 to 79 have been plotted against depth. For station 71 double values have been entered, corresponding to the adopted depths, and corresponding to the depths which have been derived, assuming the wire angle to be constant. It is seen that the former lie very nearly on the curve which is derived from the observations at the other stations in this region whereas the latter lie off this curve.

From the table it is seen that the depths of observations are always less than the wire length and that the difference increases with increasing wire length, reaching a value of 382 meters at a wire length of 3345 meters. These figures also demonstrate the importance of the direct determination of the depths at which the temperatures were measured and from which water samples were taken.

A compilation of the differences between wire lengths and actual depths of observation has not been undertaken and in the tables of results (Oceanography I-B) only the actual depths have been entered. At the greater number of stations these have been determined accurately by means of the above method, but in some instances the pressure thermometers have not functioned properly and the depths are, therefore, doubtful. In the tables of results special remarks are entered in each such case. In this place attention shall also be called to the fact that overlapping values of temperature and salinity have been obtained at a number of stations at which the greatest depth of the shallow series has been selected slightly greater than the smallest depth on the deep series. These overlapping values do not always fall on a smooth curve. The reason may be that a time change has taken place, but the reason may also be that the depths are slightly in error. An inspection of the temperature graphs shows that errors of ± 10 meters in the depth which as a rule would account for the discrepancies and errors of this magnitude are not excluded.





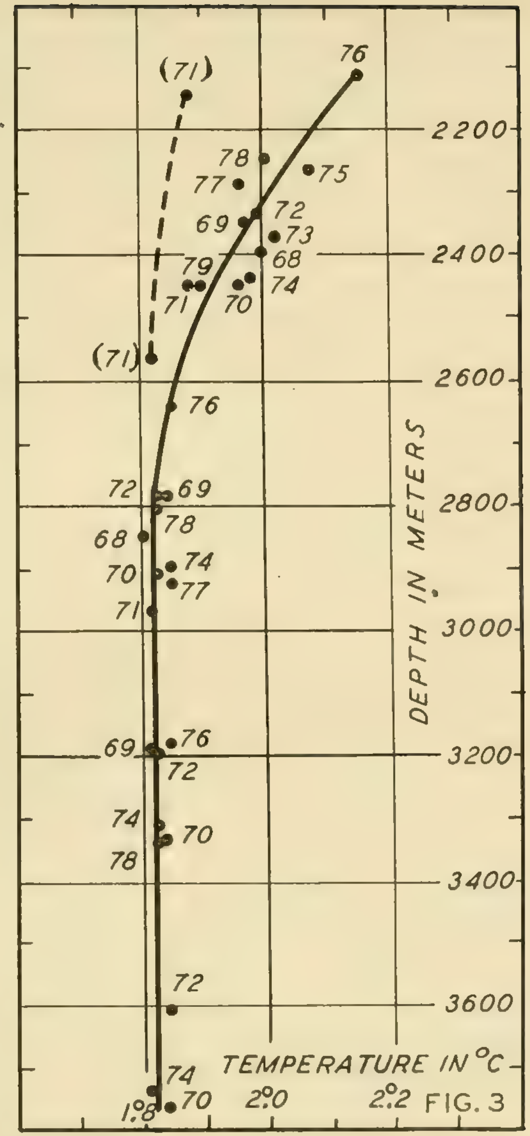


FIG. I—RATIO BETWEEN DEPTH AND WIRE LENGTH AT CARNEGIE STATION 71 (X = RESULTS FROM SHALLOW SERIES; ● = RESULTS FROM DEEP SERIES)

FIG. 2—HEAVY LINE SHOWS CURVE FORMED WHEN WATER BOTTLES OF DEEP SERIES WERE REVERSED AND LIGHT LINE POSITION WIRE WOULD HAVE ASSUMED ON BASIS CONSTANT WIRE ANGLE AT CARNEGIE STATION 71

FIG. 3—TEMPERATURES AT DEPTHS BELOW 2000 METERS FOR CARNEGIE STATIONS 68 TO 79; VALUES FOR STATIONS ALSO SHOWN ON BASIS OF CONSTANT WIRE ANGLE

NOTE ON THE PRACTICAL CORRECTION OF DEEP-SEA REVERSING THERMOMETERS AND THE DETERMINATION OF THE DEPTH OF REVERSAL FROM PROTECTED AND UNPROTECTED THERMOMETERS

Because of its simplicity and its elementary character, little has been published regarding the actual steps involved in the practical reduction of the readings of the deep-sea reversing thermometers, protected and unprotected, to obtain temperatures and depths. Yet, judging from the number of requests for such information, there seems to be a need for its publication. The aim of this article is to supply that need and no claim of originality is made for the following.

In a reversing thermometer there are two corrections which must be applied. One is the index or scale correction, I, which arises from irregularities in the cross section of the capillary tube, and the other is a temperature-difference correction arising from the fact that the temperature at which the thermometer is read is usually different from the temperature at which it was reversed. The index correction is determined by calibration and is dependent only on the reading of the thermometer. As the temperature-difference correction is a correction for expansion, however, it depends on both the reading of the thermometer and the temperature at which it is read. Since the exact temperature-difference correction involves the temperature of reversal which is unknown, the practical formula used is an approximation which may take various forms. In the Russian Oceanographical Tables, 1931, compiled by N. N. Subow, S. W. Boujewicz, and Was. W. Shoulejkin, the correction for protected thermometers has the form

$$\Delta T = \left[\frac{(T' - t)\,(T' + v_0)}{K}\right]\left[1 + \frac{(T' + v_0)}{K}\right] + I$$

where ΔT is the total correction, T' is the reading of the main thermometer, t is the reading of the auxiliary thermometer (the temperature at which the reversing thermometer is read), v_0 is the volume of mercury in the thermometer after reversal at 0° C expressed as degrees, K is a constant depending on the relative thermal coefficient of expansion of mercury and the glass of which the thermometer is made, and I is the index correction.

In the Memoirs of the Imperial Marine Observatory (1932), Koji Hidaka gives the correction for protected thermometers as

$$\Delta T = \frac{(T' - t)\,(T' + v_0)}{K\left[1 - \frac{(T' + v_0 - t)}{K}\right]} + I$$

where the symbols all have the significance described above.

The correction given by Schumacher (1923) is, using the same symbols

$$\Delta T = \left[\frac{(T' - t)\,(T' + v_0)}{K}\right]\left[1 + \frac{(T' - t) + (T' + v_0)}{K}\right] + I$$

As an unprotected thermometer is used in conjunction with a protected thermometer, the temperature of reversal is known from the protected thermometer. The temperature-difference correction, in the case of an unprotected thermometer, is therefore more simple, and the total correction is

$$\Delta T = \frac{(T_W - t)\,(T' + v_0)}{K} + I$$

where T_W is the temperature of reversal as determined by the protected thermometer and where the other symbols have the same significance as before.

The constant K is determined by the quality of the glass, and is 6100 for Jena 59^{iii} and 6300 for Jena 16^{iii}. As most deep-sea reversing thermometers are made from either one or the other of these kinds of glass, it is possible to prepare a table, based on one or the other of these values of K, giving the value of the temperature-difference correction for different values of $(T' - t)$ and $(T' + v_0)$. If two tables are prepared, one for K = 6100 and one for K = 6300, it is then possible by their use to correct any protected thermometer whose index correction has been determined. Similar tables may also be prepared for unprotected thermometers, but such tables should give the correction for different values of $(T_W - t)$ and $(T' + v_0)$. Such tables may be converted into graphical form.

The time required at sea for reducing observations, however, is greatly lessened by the preparation ashore of complete correction graphs for individual thermometers. Such graphs may be constructed as follows: If C represents the temperature-difference correction, we have from Schumacher's formula for protected thermometers given above

$$C = \frac{(T' - t)\,(T' + v_0)}{K} + \frac{(T' - t)\,(T' + v_0)^2 + (T' - t)^2(T' + v_0)}{K^2}$$

or, rearranging

$$(T' - t)^2\,\frac{(T' + v_0)}{K^2} + (T' - t)\left[\frac{(T' + v_0)^2 + K(T' + v_0)}{K^2}\right] - C = 0$$

whence

$$(T' - t) = -\,\frac{(T' + v_0 + K)}{2} + \sqrt{\frac{(T' + v_0 + K)^2}{4} + \frac{K^2}{(T' + v_0)}C}$$

Now if the radical of the right-hand member of the above equation is expanded by the binomial theorem, we have

$$(T' - t) = \frac{K^2}{(T' + v_0 + K)\,(T' + v_0)}\,C\; -$$

$$\frac{K^4}{(T' + v_0 + K)^3(T' + v_0)^2}C^2 + \frac{2K^6}{(T' + v_0 + K)^5(T' + v_0)^3}C^3 \ldots$$

Now T' is assigned a selected value near one extreme of the range of the thermometer and $(T' - t)$ is evaluated as C is assigned different values in steps of 0.01 from 0.00 to such a figure as will give the temperature

difference $(T' - t)$ as large a value as is necessary to cover the anticipated conditions. Except in restricted environments (such as polar summers) this value of $(T' - t)$ will probably be about 30° since water temperatures as low as about 0° may be expected, and reading temperatures as high as 30° are common. The process is then repeated with T' assigned an even-degree value near the other extreme of the range of the thermometer. For most thermometers, the first two terms on the right-hand side of the above equation determine the value of $(T' - t)$ with sufficient accuracy.

The correction graph may now be constructed on cross-section paper with the readings of the reversing thermometer (T') as ordinates and the corrected readings of the auxiliary thermometer (t) as abscissae. A convenient scale is 0.°1 to the millimeter. The length of the plotting sheet should be somewhat longer than three times the length of the finished graph which will occupy approximately the middle third of the original plotting sheet. On this graph the line of zero correction will be a 45°-line through all points of $T' = t$. This line is drawn lightly through those values of T' for which the index correction is known.

The values of $(T' - t)$ computed as mentioned above, are then laid off as points measured from the zero-correction line along the appropriate T' lines, one near the upper edge and one near the lower edge of the graph. These points are laid off in both directions from the zero-correction line since the correction may have either sign. Straight lines approximately parallel to the zero-correction line, representing lines of equal temperature-difference correction, are then drawn lightly through those values of T' for which the index correction is known. The graph would now be complete if there were no index corrections, but the lines must be shifted either to the right or to the left at all values of T' where the index correction is not zero. Thus, if at 0° the index correction is +0.°01, the zero-correction line as well as all the other correction lines at $T' = 0°$ are shifted one line (or 0.°01 correction) to the right. When these shifts have been made to accommodate all known index corrections, the resulting graph consists of a number of zigzag lines, all approximately parallel and having an approximade 45°-trend. The correction lines exterior to the required range of T' and t may now be cut off and the graph is ready for use. A specimen correction graph is shown in figure 1.

As described above, the lines of equal correction for temperature difference between reversal and reading are assumed to be straight. As this assumption is not exactly true, an error is introduced. This error is greater, the greater the interval between the two values of T' for which the points are computed, and is greater, the greater the numerical value of $(T' - t)$. As an example of the magnitude of this error, let us take a graph for a thermometer whose range is 0° to +20° C and prepared for a maximum value of $t = 30°$ C. In this case the maximum error in the graph will occur in the neighborhood of $T' = 10°$ and $t = 30°$ where the error will be approximately 0.003° C. Such an error is not usually significant, but if greater accuracy is desired the values of $(T' - t)$ can be computed for intervening values of T', thus breaking the single straight lines into two or more parts. Because of the increased labor required in this procedure and the small magnitude of the error involved, the refinement is not recommended.

In the case of unprotected thermometers, where C is again the temperature-difference correction

$$(T_W - t) = \frac{CK}{(T' + v_0)}$$

As with the protected thermometers, the temperature difference $(T_W - t)$ is evaluated for a series of C which is varied in steps of 0.°01 and the computations carried through for two extreme values of T'. Now, however, a plot of $(T_W - t)$ against T' is to be prepared but is carried out in much the same manner as the previously described plot of T' against t, the index correction shifts being made as before.

Having determined the corrected readings of a protected thermometer and its accompanying unprotected thermometer, the depth at which they were reversed can be computed from the formula

$$D = \frac{(T_u - T)}{Q\rho_m}$$

where D is the depth in meters, T_u is the corrected reading of the unprotected thermometer, T is the true temperature given by the corrected reading of the protected thermometer, Q is the pressure constant of the unprotected thermometer or the change in number of degrees in the corrected reading of the unprotected thermometer produced by a change in pressure of one-tenth kilogram per square centimeter, and ρ_m is the mean specific gravity of the water column above the thermometers when they were reversed. The constant Q is of the order of magnitude of 0.01 and is given in the thermometer certificate, usually in the form of the degrees change in reading per kilogram per square centimeter change in pressure.

The approximate depth of the various water bottles and thermometers will be known from the wire angle and the readings of the meter wheel. From the corrected temperatures and the salinity measurements, the density (σ_t) of the water samples can be determined from Knudsen's "Hydrographical tables." Knowing these values, the values of density in situ (σ_{tD}) are determined by applying three corrections, each of which is given in tabular form in Hesselberg and Sverdrup's paper in Bergens Museums Aarbok, 1914-1915. The most important of these corrections is a function of depth, and since the exact depth of the samples is unknown the resulting values of density in situ will be only approximate. These values are then plotted against their approximate depths, a curve drawn, and a value of the mean density scaled from the curve at half the approximate depth. It is to be remembered that this density-depth chart is constructed solely for the purpose of determining a mean density which is to be used as a factor in the reduction of thermometer depths. It is only necessary to determine this mean density to the nearest unit in the third decimal place; for example, to know that the mean density is 1.034 rather than 1.033 or 1.035. In terms of σ_{tD} this would mean the nearest unit. As the order of magnitude of depth variation of σ_{tD} is about one unit per 200 meters, it is easily seen that the density-depth curve need not be very accurate. After the adjusted depths of the samples have been determined in this manner, and the vertical distribution curves of salinity and temperature have been drawn, these may be

scaled for salinity and temperature at selected depths and values of σ_{tD} computed for these depths. The values of σ_{tD} so derived may then be used to construct a more accurate density-depth curve which can be used to check the values of mean density used in the reduction of the thermometer depths. If the values do not check within the limits mentioned above, a second approximation must be made, but this will rarely be necessary.

From the foregoing it will be seen that one meter in depth corresponds to a difference of about 0°.01 C between the corrected readings of the protected and unprotected thermometers. Experience has shown that unprotected thermometers having a range of about 60° C divided into 1/5° can be read with an accuracy of better than 0°.01. Comparisons of thermometer depths with depths determined by wire length when the wire angle was small indicate that the method gives depths reliable to within about ±10 meters. The use of unprotected thermometers at intervals along the length of a wire to which a number of water bottles is attached, in conjunction with meter-wheel readings, thus provides a satisfactory method of determining the depths of all the water bottles on the wire.

LITERATURE CITED

Hidaka, K. 1932. Mem. Imp. Marine Obs. Vol. 5, no. 1, p. 11. Kobe, Japan.

Schumacher, A. 1923. Ann. Hydrogr. Vol. 51, p. 273.

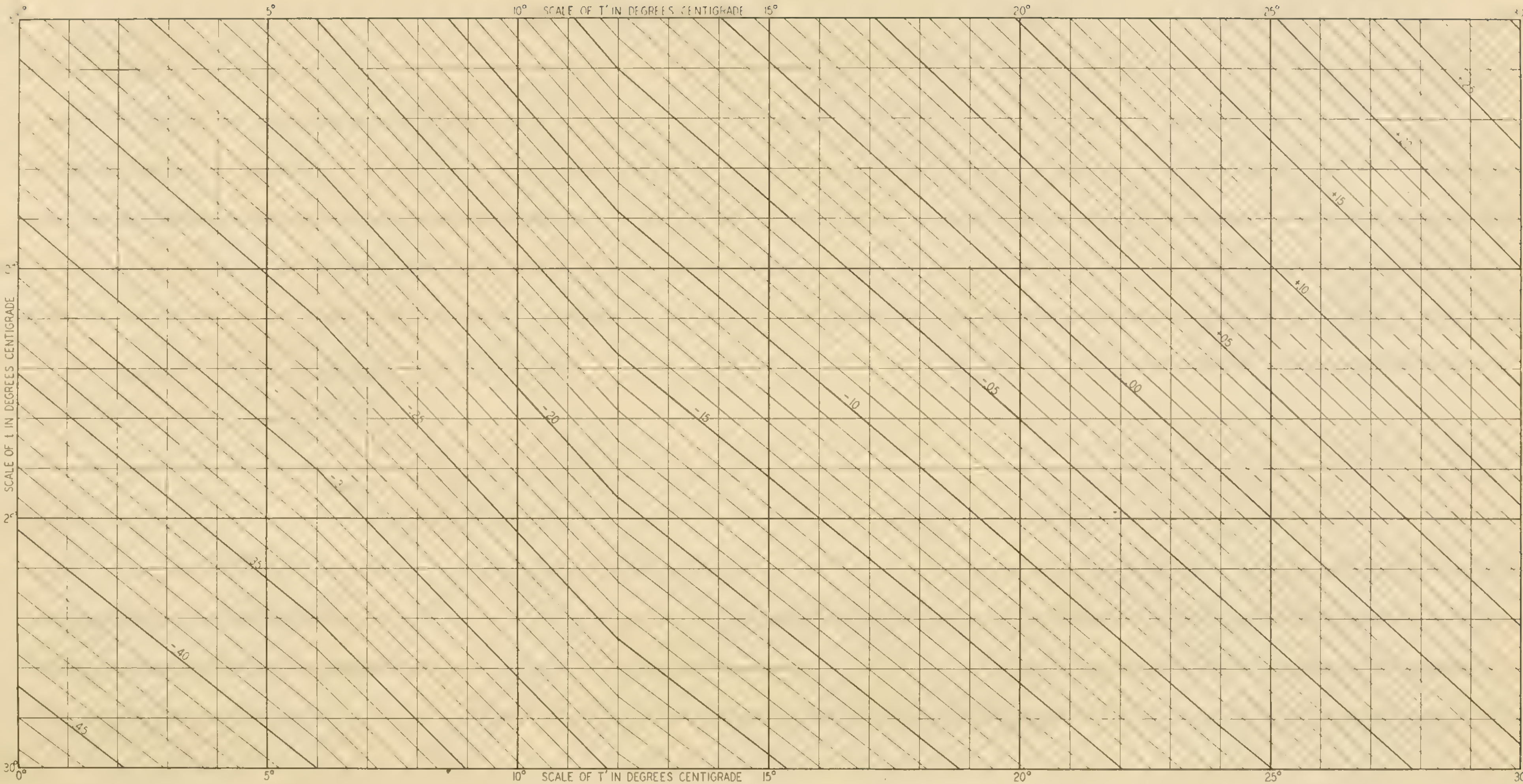


FIG. 1—GRAPH SHOWING CORRECTIONS FOR PROTECTED DEEP-SEA REVERSING THERMOMETERS BASED ON $(T'-t)=\frac{CK^2}{(T'+v_0+K)(T'+v_0)}-\frac{C^2K^4}{(T'+v_0+K)^2(T'+v_0)^2}$ FOR $v_0=95°$ AND JENA GLASS 59^{III} FOR WHICH K=6100

ASSUMING VALUES OF READINGS MAIN THERMOMETERS, T,' AND OF INDEX CORRECTIONS, I, AS FOLLOWS:

T'	0°	6°	12°	18°	24°	30°
I	0°.00	0°.00	+0°.02	+0°.01	0°.00	-0°.01

NOTE ON COMPUTATION OF DENSITY OF SEA WATER AND ON CORRECTIONS FOR DEEP-SEA REVERSING THERMOMETERS

In the reductions of the oceanographic observations made on board the Carnegie during her seventh cruise, it was fqund necessary to devise methods by which the great amount of computational work involved might be simplified and reduced.

A considerable part of this work was the determination of the density of sea water from its values of salinity and temperature, for which purpose special tables were prepared in the Department of Terrestrial Magnetism.

Table 1 is a table prepared for computing the density, $_t$, being based on the formula

$$\sigma_t = \Sigma_t + (\sigma_0 + 0.1324)\,[1 - A_t + B_t\,(\sigma_0 - 0.1324)] \quad (1)$$

together with the values of the involved constants as given in Knudsen's "Hydrographical tables."

Experience has proved the table more satisfactory than graphs because of the more or less unwieldy graphs resulting from the scale requirements imposed by the requisite degree of refinement.

Table 2 gives the corrections for depth and temperature and for depth and salinity necessary to reduce the values of density, σ_t, to those in situ, σ_{tD}. It is a modification of the tables of Hesselberg and Sverdrup to the extent that the separate corrections for depth and for temperature of the latter tables have been combined, thus reducing the number of entries from three to two.

A similar modification was made of the Hesselberg and Sverdrup correction tables for computing specific volume and dynamic depth.

The accompanying graph (fig. 1) was devised for determining the corrections for unprotected deep-sea reversing thermometers. It is based on the formula for correction

$$\Delta t = \frac{(T_w + v_0)\,(T' - t)}{K} \quad (2)$$

in which T_w is the recorded temperature of the unprotected thermometer, T' the recorded temperature of main thermometer, t is the recorded temperature (corrected) of auxiliary thermometer, v_0 is the volume of broken-off column of mercury at 0°, and K the coefficient of expansion of the glass (Jena 59^{iii} for the thermometers used on the Carnegie, for which K = 6100).

Because of the large number of thermometers used in the Carnegie observations, it was not deemed expedient to use graphs for obtaining the corrections for the protected thermometers, since, because of the different values of v_0, it would have been necessary to construct a graph for each thermometer.

Instead a table, of which table 3 is a specimen sheet, was prepared which covered all the Carnegie values of the tabular arguments and was based on the formula for correction

$$\Delta t = \frac{(T' + v_0)\,(T' - t)}{K} + I + \frac{T' + v_0}{K}\left[\frac{(T' + v_0)\,(T' - t)}{K} + I\right] \quad (3)$$

T' and t denoting, respectively, the recorded temperatures of the main and auxiliary thermometers, I denoting the index correction of the main thermometer, and v_0 and K having the same significance as in equation (2). Making K = 6100, equation (3) reduces to

$$\Delta t = 0.000164\,(T' + v_0)\,(T' - t)\,[1 + 0.000164\,(T' + v_0)] + I + 0.000164\,I\,(T' + v_0) \quad (4)$$

The first term of the right-hand member of (4) is represented by the tabular values in table 3, hence Δt = tabular value + I + 0.000164 I $(T' + v_0)$. The term 0.000164 I $(T' + v_0)$, may be considered negligible for well-made thermometers for which I does not exceed 0°.10.

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t

Tabular values give excess of density over unity in units of fifth decimal: thus for S = 34.2 ‰ and t = 4.°55 C, density is 1.02711

Temperature, t	Salinity, S, in ‰										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
-2.00	2739	2747	2755	2763	2772	2780	2789	2797	2804	2812	2820
-1.95	39	47	55	63	71	80	88	96	04	12	20
-1.90	39	47	55	63	71	79	87	96	04	12	20
-1.85	39	47	55	63	71	79	87	95	04	12	20
-1.80	39	47	55	63	71	79	87	95	03	12	20
-1.75	38	46	55	63	71	79	87	95	03	11	19
-1.70	38	46	54	63	71	79	87	95	03	11	19
-1.65	38	46	54	62	71	79	87	95	03	11	19
-1.60	38	46	54	62	70	78	87	95	03	11	19
-1.55	38	46	54	62	70	78	86	95	03	11	19
-1.50	2738	2746	2754	2762	2770	2778	2786	2794	2802	2811	2819
-1.45	38	46	54	62	70	78	86	94	02	10	19
-1.40	37	46	54	62	70	78	86	94	02	10	18
-1.35	37	45	53	62	70	78	86	94	02	10	18
-1.30	37	45	53	61	69	78	86	94	02	10	18
-1.25	37	45	53	61	69	77	86	94	02	10	18
-1.20	37	45	53	61	69	77	85	93	02	10	18
-1.15	37	45	53	61	69	77	85	93	01	09	18
-1.10	37	45	53	61	69	77	85	93	01	09	17
-1.05	36	45	53	61	69	77	85	93	01	09	17
-1.00	2736	2744	2752	2761	2769	2777	2785	2793	2801	2809	2817
-0.95	36	44	52	60	68	76	85	93	01	09	17
-0.90	36	44	52	60	68	76	84	92	00	09	17
-0.85	36	44	52	60	68	76	84	92	00	08	16
-0.80	35	43	52	60	68	76	84	92	00	08	16
-0.75	35	43	51	59	67	76	84	92	00	08	16
-0.70	35	43	51	59	67	75	83	91	00	08	16
-0.65	35	43	51	59	67	75	83	91	2799	07	15
-0.60	35	43	51	59	67	75	83	91	99	07	15
-0.55	35	42	51	59	67	75	83	91	99	07	15
-0.50	2734	2742	2750	2758	2766	2774	2783	2791	2799	2807	2815
-0.45	34	42	50	58	66	74	82	90	98	07	15
-0.40	34	42	50	58	66	74	82	90	98	06	14
-0.35	34	42	50	58	66	74	82	90	98	06	14
-0.30	33	41	49	57	66	74	82	90	98	06	14
-0.25	33	41	49	57	65	73	81	89	98	06	14
-0.20	33	41	49	57	65	73	81	89	97	05	13
-0.15	33	41	49	57	65	73	81	89	97	05	13
-0.10	32	40	49	57	65	73	81	89	97	05	13
-0.05	32	40	48	56	64	72	81	89	97	05	13
0.00	2732	2740	2748	2756	2764	2772	2780	2788	2796	2805	2813
0.05	32	40	48	56	64	72	80	88	96	04	12
0.10	31	39	48	56	64	72	80	88	96	04	12
0.15	31	39	47	55	63	71	79	87	96	04	12
0.20	31	39	47	55	63	71	79	87	95	03	11
0.25	31	39	47	55	63	71	79	87	95	03	11
0.30	30	38	46	54	62	71	79	87	95	03	11
0.35	30	38	46	54	62	70	78	86	94	02	10
0.40	30	38	46	54	62	70	78	86	94	02	10
0.45	29	37	46	54	62	70	78	86	94	02	10
0.50	2729	2737	2745	2753	2761	2770	2777	2785	2793	2802	2810
0.55	29	37	45	53	61	69	77	85	93	01	09
0.60	29	37	45	53	61	69	77	85	93	01	09
0.65	28	36	44	52	60	69	77	85	93	01	09
0.70	28	36	44	52	60	68	76	84	92	00	08
0.75	28	36	44	52	60	68	76	84	92	00	08
0.80	27	35	43	51	59	68	76	84	92	00	08
0.85	27	35	43	51	59	67	75	83	91	2799	08
0.90	27	35	43	51	59	67	75	83	91	99	07
0.95	27	35	43	51	59	67	75	83	91	99	07
1.00	2726	2734	2742	2750	2758	2766	2774	2783	2791	2799	2807
1.05	26	34	42	50	58	66	74	82	90	98	06
1.10	26	34	42	50	58	66	74	82	90	98	06
1.15	25	33	41	49	57	65	73	81	89	97	06
1.20	25	33	41	49	57	65	73	81	89	97	05

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem-pera-ture, t	Salinity, S, in $^{0}/oo$										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
1.25	2725	2733	2741	2749	2757	2765	2773	2781	2789	2797	2805
1.30	24	32	40	48	56	64	72	80	88	96	04
1.35	24	32	40	48	56	64	72	80	88	96	04
1.40	23	32	40	48	56	64	72	80	88	96	04
1.45	23	31	39	47	55	63	71	79	87	95	03
1.50	2723	2731	2739	2747	2755	2763	2771	2779	2787	2795	2803
1.55	22	30	38	46	54	63	71	79	87	95	03
1.60	22	30	38	46	54	62	70	78	86	94	02
1.65	22	30	38	46	54	62	70	78	86	94	02
1.70	21	29	37	45	53	61	69	77	85	93	01
1.75	21	29	37	45	53	61	69	77	85	93	01
1.80	21	29	37	45	53	61	69	77	85	93	01
1.85	20	28	36	44	52	60	68	76	84	92	00
1.90	20	28	36	44	52	60	68	76	84	92	00
1.95	20	28	36	44	52	60	68	76	84	92	00
2.00	2719	2727	2735	2743	2751	2759	2767	2775	2783	2791	2799
2.05	19	27	35	43	51	59	67	75	83	91	99
2.10	18	26	34	42	50	58	66	74	82	90	98
2.15	18	26	34	42	50	58	66	74	82	90	98
2.20	18	26	34	42	50	58	66	74	82	90	98
2.25	17	25	33	41	49	57	65	73	81	89	97
2.30	17	25	33	41	49	57	65	73	81	89	97
2.35	16	24	32	40	48	56	64	72	80	88	96
2.40	16	24	32	40	48	56	64	72	80	88	96
2.45	15	23	31	39	47	55	63	71	79	87	95
2.50	2715	2723	2731	2739	2747	2755	2763	2771	2779	2787	2795
2.55	15	23	31	39	47	55	63	71	79	87	95
2.60	14	22	30	38	46	54	62	70	78	86	94
2.65	14	22	30	38	46	54	62	70	78	86	94
2.70	13	21	29	37	45	53	61	69	77	85	93
2.75	13	21	29	37	45	53	61	69	77	85	93
2.80	13	21	29	37	44	52	60	68	76	84	92
2.85	12	20	28	36	44	52	60	68	76	84	92
2.90	12	20	28	36	44	52	60	68	76	84	91
2.95	11	19	27	35	43	51	59	67	75	83	91
3.00	2711	2719	2727	2735	2743	2751	2759	2767	2775	2783	2791
3.05	10	18	26	34	42	50	58	66	74	82	90
3.10	10	18	26	34	42	50	58	66	74	82	90
3.15	09	17	25	33	41	49	57	65	73	81	89
3.20	09	17	25	33	41	49	57	65	73	81	89
3.25	08	16	24	32	40	48	56	64	72	80	88
3.30	08	16	24	32	40	48	56	64	72	80	88
3.35	08	15	23	31	39	47	55	63	71	79	87
3.40	07	15	23	31	39	47	55	63	71	79	87
3.45	07	14	22	30	38	46	54	62	70	78	86
3.50	2706	2714	2722	2730	2738	2746	2754	2762	2770	2778	2786
3.55	06	14	22	29	37	45	53	61	69	77	85
3.60	05	13	21	29	37	45	53	61	69	77	85
3.65	05	13	21	29	36	44	52	60	68	76	84
3.70	04	12	20	28	36	44	52	60	68	76	84
3.75	04	12	20	28	35	43	51	59	67	75	83
3.80	03	11	19	27	35	43	51	59	67	75	83
3.85	03	11	19	27	35	42	50	58	66	74	82
3.90	02	10	18	26	34	42	50	58	66	74	82
3.95	02	10	18	26	34	41	49	57	65	73	81
4.00	2701	2709	2717	2725	2733	2741	2749	2757	2765	2773	2781
4.05	01	09	17	25	33	40	48	56	64	72	80
4.10	00	08	16	24	32	40	48	56	64	72	80
4.15	00	08	16	23	31	39	47	55	63	71	79
4.20	2699	07	15	23	31	39	47	55	63	71	79
4.25	99	07	14	22	30	38	46	54	62	70	78
4.30	98	06	14	22	30	38	46	54	62	69	77
4.35	97	05	13	21	29	37	45	53	61	69	77
4.40	97	05	13	21	29	37	45	52	60	68	76
4.45	96	04	12	20	28	36	44	52	60	68	76

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Temperature, t	Salinity, S, in $^0/oo$										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
4.50	2696	2704	2712	2720	2728	2736	2743	2751	2759	2767	2775
4.55	95	03	11	19	27	35	43	51	59	67	75
4.60	95	03	11	19	26	34	42	50	58	66	74
4.65	94	02	10	18	26	34	42	50	58	66	74
4.70	94	02	10	17	25	33	41	49	57	65	73
4.75	93	01	09	17	25	33	41	49	57	64	72
4.80	93	01	08	16	24	32	40	48	56	64	72
4.85	92	00	08	16	24	32	40	48	55	63	71
4.90	92	2699	07	15	23	31	39	47	55	63	71
4.95	91	99	07	15	23	31	38	46	54	62	70
5.00	2690	2698	2706	2714	2722	2730	2738	2746	2754	2762	2770
5.05	90	98	06	14	22	29	37	45	53	61	69
5.10	89	97	05	13	21	29	37	45	53	60	68
5.15	89	97	04	12	20	28	36	44	52	60	68
5.20	88	96	04	12	20	28	36	43	51	59	67
5.25	87	95	03	11	19	27	35	43	51	59	67
5.30	87	95	03	11	18	26	34	42	50	58	66
5.35	86	94	02	10	18	26	34	42	50	57	65
5.40	86	94	01	09	17	25	33	41	49	57	65
5.45	85	93	01	09	17	25	32	40	48	56	64
5.50	2684	2692	2700	2708	2716	2724	2732	2740	2748	2756	2763
5.55	84	92	00	08	15	23	31	39	47	55	63
5.60	83	91	2699	07	15	23	31	39	46	54	62
5.65	83	91	98	06	14	22	30	38	46	54	62
5.70	82	90	98	06	14	22	29	37	45	53	61
5.75	81	89	97	05	13	21	29	37	45	53	60
5.80	81	89	97	05	12	20	28	36	44	52	60
5.85	80	88	96	04	12	20	28	35	43	51	59
5.90	80	87	95	03	11	19	27	35	43	51	59
5.95	79	87	95	03	11	18	26	34	42	50	58
6.00	2678	2686	2694	2702	2710	2718	2726	2734	2742	2749	2757
6.05	78	86	94	01	09	17	25	33	41	49	57
6.10	77	85	93	01	09	17	24	32	40	48	56
6.15	76	84	92	00	08	16	24	32	40	47	55
6.20	76	84	92	2699	07	15	23	31	39	47	55
6.25	75	83	91	99	07	15	22	30	38	46	54
6.30	74	82	90	98	06	14	22	30	38	45	53
6.35	74	82	90	97	05	13	21	29	37	45	53
6.40	73	81	89	97	05	13	20	28	36	44	52
6.45	72	80	88	96	04	12	20	28	36	43	51
6.50	2772	2680	2688	2695	2703	2711	2719	2727	2735	2743	2751
6.55	71	79	87	95	03	11	18	26	34	42	50
6.60	70	78	86	94	02	10	18	26	34	41	49
6.65	70	78	86	93	01	09	17	25	33	41	49
6.70	69	77	85	93	01	09	16	24	32	40	48
6.75	69	76	84	92	00	07	16	24	32	39	47
6.80	68	76	84	91	2699	07	15	23	31	39	47
6.85	67	75	83	91	99	06	14	22	30	38	46
6.90	67	74	82	90	98	05	14	22	30	31	45
6.95	66	74	82	89	97	05	13	21	29	37	45
7.00	2665	2673	2681	2689	2697	2705	2712	2720	2728	2736	2744
7.05	64	72	80	88	96	04	12	20	27	35	43
7.10	64	72	80	87	95	03	11	19	27	35	42
7.15	63	71	79	87	95	02	10	18	26	34	42
7.20	62	70	78	86	94	02	10	17	25	33	41
7.25	62	70	77	85	93	01	09	17	25	32	40
7.30	61	69	77	85	92	00	08	16	24	32	40
7.35	60	68	76	84	92	00	07	15	23	31	39
7.40	60	67	75	83	91	2699	07	15	22	30	38
7.45	59	67	74	82	90	98	06	14	22	29	37
7.50	2658	2666	2674	2682	2689	2697	2705	2713	2721	2729	2737
7.55	57	65	73	81	89	97	04	12	20	28	36
7.60	57	64	72	80	88	96	04	12	19	27	35
7.65	56	64	72	79	87	95	03	11	19	27	34
7.70	55	63	71	79	87	94	02	10	18	26	34
7.75	54	62	70	78	86	94	02	09	17	25	33
7.80	54	62	69	77	85	93	01	09	17	24	32
7.85	53	61	69	77	84	92	00	08	15	24	32
7.90	52	60	68	76	84	92	2699	07	15	23	31
7.95	52	59	67	75	83	91	99	07	14	22	30

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem-pera-ture, t	Salinity, S, in $^{0}/oo$										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
8.00	2651	2659	2667	2674	2682	2690	2698	2706	2714	2722	2729
8.05	50	58	66	74	82	89	97	05	13	21	29
8.10	49	57	65	73	81	89	96	04	12	20	28
8.15	49	56	64	72	80	88	96	03	11	19	27
8.20	48	56	64	71	79	87	95	03	11	18	26
8.25	47	55	63	71	78	86	94	02	10	18	26
8.30	46	54	62	70	78	85	93	01	09	17	25
8.35	46	53	61	69	77	85	93	00	08	16	24
8.40	45	53	60	68	76	84	92	00	07	15	23
8.45	44	52	60	68	75	83	91	2649	07	15	22
8.50	2643	2651	2659	2667	2675	2682	2690	2698	2706	2714	2722
8.55	42	50	58	66	74	82	89	97	05	13	21
8.60	42	50	57	65	73	81	89	97	04	12	20
8.65	41	49	57	64	72	80	88	96	04	11	19
8.70	40	48	56	64	71	79	87	95	03	11	18
8.75	39	47	55	63	71	79	86	94	02	10	18
8.80	39	46	54	62	70	78	86	93	01	09	17
8.85	38	46	54	61	69	77	85	93	01	08	16
8.90	37	45	53	61	68	76	84	92	00	07	15
8.95	36	44	52	60	68	75	83	91	2699	07	15
9.00	2636	2643	2651	2659	2667	2675	2682	2690	2698	2706	2714
9.05	35	43	50	58	66	74	82	89	97	05	13
9.10	34	42	50	57	65	73	81	89	96	04	12
9.15	33	41	49	57	64	72	80	88	96	03	11
9.20	32	40	48	56	64	71	79	87	95	03	10
9.25	31	39	47	55	63	71	78	86	94	02	10
9.30	31	38	46	54	62	70	77	85	93	01	09
9.35	30	38	45	53	61	69	77	84	92	00	08
9.40	29	37	45	52	60	68	76	84	91	2699	07
9.45	28	36	44	52	59	67	75	83	91	98	06
9.50	2627	2635	2643	2651	2659	2666	2674	2682	2690	2698	2705
9.55	27	34	42	50	58	66	73	81	89	97	05
9.60	26	33	41	49	57	65	73	80	88	96	04
9.65	25	33	40	48	56	64	72	80	87	95	03
9.70	24	32	40	47	55	63	71	79	86	94	02
9.75	23	31	39	47	54	62	70	78	86	93	01
9.80	22	30	38	46	54	61	69	77	85	93	00
9.85	22	29	37	45	53	61	68	76	84	92	00
9.90	21	29	36	44	52	60	68	75	83	91	2699
9.95	20	28	36	43	51	59	67	75	82	90	98
10.00	2619	2627	2635	2643	2650	2658	2666	2674	2681	2689	2697
10.05	18	26	34	42	49	57	65	73	81	88	96
10.10	17	25	33	41	49	56	64	72	80	88	95
10.15	16	24	32	40	48	55	63	71	79	87	94
10.20	16	23	31	39	47	55	62	70	78	86	94
10.25	15	23	30	38	46	54	62	69	77	85	93
10.30	14	22	29	37	45	53	61	68	76	84	92
10.35	13	21	29	36	44	52	60	68	75	83	91
10.40	12	20	28	36	43	51	59	67	74	82	90
10.45	11	19	27	35	42	50	58	66	74	81	89
10.50	2610	2618	2626	2634	2642	2649	2657	2665	2673	2680	2688
10.55	09	17	25	33	41	48	56	64	72	80	87
10.60	09	16	24	32	40	48	55	63	71	79	86
10.65	08	16	23	31	39	47	54	62	70	78	86
10.70	07	15	22	30	38	46	54	61	69	77	85
10.75	06	14	22	29	37	45	53	61	68	76	84
10.80	05	13	21	28	36	44	52	60	67	75	83
10.85	04	12	20	28	35	43	51	59	67	74	82
10.90	03	11	19	27	35	42	50	58	66	73	81
10.95	02	10	18	26	34	41	49	57	65	72	80
11.00	2602	2609	2617	2625	2633	2641	2648	2656	2664	2672	2679
11.05	01	08	16	24	32	40	47	55	63	71	78
11.10	00	08	15	23	31	39	46	54	62	70	78
11.15	2599	07	14	22	30	38	46	53	61	69	77
11.20	98	06	14	21	29	37	45	52	60	68	76
11.25	97	05	13	20	28	36	44	51	59	67	75
11.30	96	04	12	19	27	35	43	51	58	66	74
11.35	95	03	11	18	26	34	42	50	57	65	73
11.40	94	02	10	18	25	33	41	49	56	64	72
11.45	93	01	09	17	24	32	40	48	55	63	71

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem-pera-ture, t	Salinity, S, in $^{0}/oo$										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
11.50	2592	2600	2608	2616	2623	2631	2639	2647	2655	2662	2670
11.55	92	2599	07	15	23	30	38	46	54	61	69
11.60	91	98	06	14	22	29	37	45	53	60	68
11.65	90	97	05	13	21	28	36	44	52	60	67
11.70	89	96	04	12	20	28	35	43	51	59	66
11.75	88	96	03	11	19	27	34	42	50	58	65
11.80	87	95	02	10	18	26	33	41	49	57	64
11.85	86	94	01	09	17	25	32	40	48	56	64
11.90	85	93	01	08	16	24	32	39	47	55	63
11.95	84	92	00	07	15	23	31	38	46	54	62
12.00	2583	2591	2599	2606	2614	2622	2630	2637	2645	2653	2661
12.05	82	90	98	05	13	21	29	37	44	52	60
12.10	81	89	97	05	12	20	28	36	43	51	59
12.15	80	88	96	04	11	19	27	35	42	50	58
12.20	79	87	95	03	10	18	26	34	41	49	57
12.25	78	86	94	02	09	17	25	33	40	48	56
12.30	77	85	93	01	08	16	24	32	39	47	55
12.35	76	84	92	00	07	15	23	31	38	46	54
12.40	75	83	91	2599	06	14	22	30	37	45	53
12.45	74	82	90	98	05	13	21	29	36	44	52
12.50	2573	2581	2589	2597	2604	2612	2620	2628	2635	2643	2651
12.55	73	80	88	96	03	11	19	27	34	42	50
12.60	72	79	87	95	02	10	18	26	33	41	49
12.65	71	78	86	94	02	09	17	25	32	40	48
12.70	70	77	85	93	01	08	16	24	32	39	47
12.75	69	76	84	92	00	07	15	23	31	38	46
12.80	68	75	83	91	2599	06	14	22	30	37	45
12.85	67	74	82	90	98	05	13	21	29	36	44
12.90	66	73	81	89	97	04	12	20	28	35	43
12.95	65	72	80	88	96	03	11	19	27	34	42
13.00	2564	2571	2579	2587	2595	2602	2610	2618	2626	2633	2641
13.05	63	70	78	86	94	01	09	17	25	32	40
13.10	62	69	77	85	93	00	08	16	24	31	39
13.15	61	68	76	84	92	2599	07	15	23	30	38
13.20	60	67	75	83	91	98	06	14	22	29	37
13.25	59	66	74	82	90	97	05	13	20	28	36
13.30	58	65	73	81	89	96	04	12	19	27	35
13.35	57	64	72	80	88	95	03	11	18	26	34
13.40	56	63	71	79	86	94	02	10	17	25	33
13.45	55	62	70	78	85	93	01	09	16	24	32
13.50	2554	2561	2569	2577	2584	2592	2600	2608	2615	2623	2631
13.55	53	60	68	76	83	91	2599	07	14	22	30
13.60	52	59	67	75	82	90	98	06	13	21	29
13.65	51	58	66	74	81	89	97	05	12	20	28
13.70	49	57	65	73	80	88	96	04	11	19	27
13.75	48	56	64	72	79	87	95	03	10	18	26
13.80	47	55	63	71	78	86	94	01	09	17	25
13.85	46	54	62	70	77	85	93	00	08	16	24
13.90	45	53	61	69	76	84	92	2599	07	15	23
13.95	44	52	60	68	75	83	91	98	06	14	22
14.00	2543	2551	2559	2567	2574	2582	2590	2597	2605	2613	2620
14.05	42	50	58	65	73	81	89	96	04	12	19
14.10	41	49	57	64	72	80	88	95	03	11	18
14.15	40	48	56	63	71	79	86	94	02	10	17
14.20	39	47	55	62	70	78	85	93	01	08	16
14.25	38	46	53	61	69	77	84	92	00	07	15
14.30	37	45	52	60	68	76	83	91	2599	06	14
14.35	36	44	51	59	67	74	82	90	98	05	13
14.40	35	43	50	58	66	73	81	89	96	04	12
14.45	34	41	49	57	65	72	80	88	95	03	11
14.50	2533	2540	2548	2556	2564	2571	2579	2587	2594	2602	2610
14.55	32	39	47	55	62	70	78	86	93	01	09
14.60	31	38	46	54	61	69	77	84	92	00	08
14.65	29	37	45	53	60	68	76	83	91	2599	07
14.70	28	36	44	52	59	67	75	82	90	98	05
14.75	27	35	43	50	58	66	74	81	89	97	04
14.80	26	34	42	49	57	65	72	80	88	96	03
14.85	25	33	41	48	56	64	71	79	87	95	02
14.90	24	32	40	47	55	63	70	78	86	93	01
14.95	23	31	38	46	54	62	69	77	85	92	00

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem-pera-ture, t	Salinity, S, in $^0/oo$										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
15.00	2522	2530	2537	2545	2553	2561	2568	2576	2584	2591	2599
15.05	21	29	36	44	52	59	67	75	82	90	98
15.10	20	28	35	43	51	58	66	74	81	89	97
15.15	19	26	34	42	49	57	65	73	80	88	96
15.20	18	25	33	41	48	56	64	71	79	87	95
15.25	16	24	32	40	47	55	63	70	78	86	93
15.30	15	23	31	38	46	54	62	69	77	85	92
15.35	14	22	30	37	45	53	60	68	76	83	91
15.40	13	21	29	36	44	52	59	67	75	82	90
15.45	12	20	27	35	43	50	58	66	74	81	89
15.50	2511	2519	2526	2534	2542	2549	2557	2565	2572	2580	2588
15.55	10	17	25	33	41	48	56	64	71	79	87
15.60	09	16	24	32	39	47	55	63	70	78	86
15.65	08	15	23	31	38	46	54	61	69	77	84
15.70	06	14	22	30	37	45	53	60	68	76	83
15.75	05	13	21	28	36	44	51	59	67	74	82
15.80	04	12	20	27	35	43	50	58	66	73	81
15.85	03	11	18	26	34	42	49	57	65	72	80
15.90	02	10	17	25	33	40	48	56	63	71	79
15.95	01	09	16	24	32	39	47	55	62	70	78
16.00	2500	2507	2515	2523	2530	2538	2546	2554	2561	2569	2577
16.05	2499	06	14	22	29	37	45	52	60	68	75
16.10	97	05	13	20	28	36	44	51	59	67	74
16.15	96	04	12	19	27	35	42	50	58	65	73
16.20	95	03	11	18	26	34	41	49	57	64	72
16.25	94	02	09	17	25	32	40	48	55	63	71
16.30	93	01	08	16	24	31	39	47	54	62	70
16.35	92	2499	07	15	22	30	38	45	53	61	68
16.40	91	98	06	14	21	29	37	44	52	60	67
16.45	89	97	05	12	20	28	35	43	51	58	66
16.50	2488	2496	2504	2511	2519	2527	2534	2542	2550	2557	2565
16.55	87	95	02	10	18	25	33	41	48	56	64
16.60	86	94	01	09	17	24	32	40	47	55	63
16.65	85	92	00	08	15	23	31	38	46	54	61
16.70	84	91	2499	07	14	22	30	37	45	53	60
16.75	82	90	98	05	13	21	28	36	44	51	59
16.80	81	89	97	04	12	20	27	35	43	50	58
16.85	80	88	95	03	11	18	26	34	41	49	57
16.90	79	87	94	02	10	17	25	33	40	48	56
16.95	78	85	93	01	08	16	24	31	39	47	54
17.00	2477	2484	2492	2500	2507	2515	2523	2530	2538	2546	2553
17.05	75	83	91	2498	06	14	21	29	37	44	52
17.10	74	82	90	97	05	13	20	28	35	43	51
17.15	73	81	88	96	04	11	19	27	34	42	50
17.20	72	79	87	95	02	10	18	25	33	41	48
17.25	71	78	86	94	01	09	17	24	32	40	47
17.30	69	77	85	92	00	08	15	23	31	38	46
17.35	68	76	83	91	2499	06	14	22	29	37	45
17.40	67	75	82	90	98	05	13	21	28	36	44
17.45	66	74	81	89	96	04	12	19	27	35	42
17.50	2465	2472	2480	2488	2495	2503	2511	2518	2526	2533	2541
17.55	63	71	79	86	94	02	09	17	25	32	40
17.60	62	70	78	85	93	00	08	16	23	31	39
17.65	61	69	76	84	92	2499	07	15	22	30	37
17.70	60	67	75	83	90	98	06	13	21	29	36
17.75	59	66	74	82	89	97	05	12	20	27	35
17.80	57	65	73	80	88	96	03	11	19	26	34
17.85	56	64	71	79	87	94	02	10	17	25	33
17.90	55	63	70	78	86	93	01	09	16	24	31
17.95	54	62	69	77	84	92	00	07	15	23	30
18.00	2453	2460	2468	2476	2483	2491	2498	2506	2514	2521	2529
18.05	51	59	67	74	82	90	97	05	13	20	28
18.10	50	58	65	73	81	88	96	04	11	19	27
18.15	49	57	64	72	79	87	95	02	10	18	25
18.20	48	55	63	71	78	86	93	01	09	16	24
18.25	46	54	62	69	77	85	92	00	08	15	23
18.30	45	53	60	68	76	83	91	2499	06	14	22
18.35	44	52	59	67	74	82	90	97	05	13	20
18.40	43	50	58	66	73	81	88	96	04	11	19
18.45	41	49	57	64	72	80	87	95	03	10	18

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Temperature, t	Salinity, S, in $^0/oo$										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
18.50	2440	2448	2455	2463	2471	2478	2486	2494	2501	2509	2516
18.55	39	47	54	62	69	77	85	92	00	08	15
18.60	38	45	53	61	68	76	83	91	2499	06	14
18.65	36	44	52	59	67	75	82	90	97	05	13
18.70	35	43	50	58	66	73	81	89	96	04	11
18.75	34	42	49	57	64	72	80	87	95	03	10
18.80	33	40	48	56	63	71	78	86	94	01	09
18.85	31	39	47	54	62	70	77	85	92	00	08
18.90	30	38	45	53	61	68	76	84	91	2499	06
18.95	29	37	44	52	59	67	75	82	90	98	05
19.00	2428	2435	2443	2451	2458	2466	2473	2481	2489	2496	2504
19.05	26	34	42	49	57	65	72	80	87	95	03
19.10	25	33	40	48	56	63	71	78	86	94	01
19.15	24	31	39	47	54	62	70	77	85	92	00
19.20	23	30	38	45	53	61	68	76	84	91	2499
19.25	21	29	37	44	52	59	67	75	82	90	98
19.30	20	28	35	43	50	58	66	73	81	89	96
19.35	19	26	34	42	49	57	64	72	80	87	95
19.40	17	25	33	40	48	56	63	71	78	86	94
19.45	16	24	31	39	47	54	62	69	77	85	92
19.50	2415	2422	2430	2438	2445	2453	2461	2468	2476	2483	2491
19.55	14	21	29	36	44	52	59	67	75	82	90
19.60	12	20	27	35	43	50	58	66	73	81	88
19.65	11	19	26	34	41	49	57	64	72	79	87
19.70	10	17	25	33	40	48	55	63	71	78	86
19.75	08	16	24	31	39	46	54	62	69	77	85
19.80	07	15	22	30	38	45	53	60	68	76	83
19.85	06	13	21	29	36	44	51	59	67	74	82
19.90	05	12	20	27	35	43	50	58	65	73	81
19.95	03	11	18	26	34	41	49	56	64	72	79
20.00	2402	2410	2417	2425	2432	2440	2448	2455	2463	2470	2478
20.05	01	08	16	23	31	39	46	54	62	69	77
20.10	2399	07	15	22	30	37	45	53	60	68	75
20.15	98	06	13	21	28	36	44	51	59	66	74
20.20	97	04	12	19	27	35	42	50	57	65	73
20.25	95	03	11	18	26	33	41	49	56	64	71
20.30	94	02	09	17	24	32	40	47	55	62	70
20.35	93	00	08	15	23	31	38	46	54	61	69
20.40	91	2399	07	14	22	29	37	45	52	60	67
20.45	90	98	05	13	20	28	36	43	51	58	66
20.50	2389	2396	2404	2411	2419	2427	2434	2442	2449	2457	2465
20.55	87	95	03	10	18	25	33	41	48	56	63
20.60	86	94	01	09	16	24	32	39	47	54	62
20.65	85	92	00	07	15	23	30	38	45	53	61
20.70	83	91	2399	06	14	21	29	37	44	52	59
20.75	82	90	97	05	12	20	28	35	43	50	58
20.80	81	88	96	03	11	19	26	34	41	49	57
20.85	79	87	95	02	10	17	25	33	40	48	55
20.90	78	86	93	01	08	16	24	31	39	46	54
20.95	77	84	92	2399	07	15	22	30	37	45	53
21.00	2375	2383	2391	2398	2406	2413	2421	2429	2436	2444	2451
21.05	74	82	89	97	04	12	20	27	35	42	50
21.10	73	80	88	95	03	11	18	26	33	41	49
21.15	71	79	86	94	02	09	17	24	32	40	47
21.20	70	77	85	93	00	08	15	23	31	38	46
21.25	69	76	84	91	2399	06	14	22	29	37	44
21.30	67	75	82	90	97	05	13	20	28	35	43
21.35	66	73	81	89	96	04	11	19	26	34	42
21.40	64	72	80	87	95	02	10	18	25	33	40
21.45	63	71	78	86	93	01	09	16	24	31	39
21.50	2362	2369	2377	2384	2392	2400	2407	2415	2422	2430	2438
21.55	60	68	75	83	91	2398	06	13	21	29	36
21.60	59	66	74	82	89	97	04	12	20	27	35
21.65	58	65	73	80	88	95	03	11	18	26	33
21.70	56	64	71	79	86	94	02	09	17	24	32
21.75	55	62	70	78	85	93	00	08	15	23	31
21.80	53	61	69	76	84	91	2399	07	14	22	29
21.85	52	60	67	75	82	90	98	05	13	20	28
21.90	51	58	66	73	81	89	96	04	11	19	26
21.95	49	57	64	72	80	87	95	02	10	18	25

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Temperature, t	Salinity, S, in °/oo										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
22.00	2348	2356	2363	2371	2378	2386	2393	2401	2409	2416	2424
22.05	46	54	62	69	77	84	92	00	07	15	22
22.10	45	53	60	68	75	83	91	2398	06	13	21
22.15	44	51	59	66	74	82	89	97	04	12	19
22.20	42	50	57	65	73	80	88	95	03	10	18
22.25	41	48	56	64	71	79	86	94	01	09	17
22.30	39	47	55	62	70	77	85	92	00	08	15
22.35	38	46	53	61	68	76	83	91	2399	06	14
22.40	37	44	52	59	67	75	82	90	97	05	12
22.45	35	43	50	58	65	73	81	88	96	03	11
22.50	2334	2341	2349	2357	2364	2372	2379	2387	2394	2402	2410
22.55	32	40	48	55	63	70	78	85	93	01	08
22.60	31	39	46	54	61	69	76	84	92	2399	07
22.65	30	37	45	52	60	67	75	83	90	97	05
22.70	28	36	43	51	58	66	74	81	89	96	04
22.75	27	34	42	49	57	65	72	80	87	95	02
22.80	25	33	40	48	56	63	71	78	86	93	01
22.85	24	31	39	47	54	62	69	77	84	92	00
22.90	22	30	38	45	53	60	68	75	83	91	2398
22.95	21	29	36	44	51	59	67	74	82	89	97
23.00	2320	2327	2335	2342	2350	2358	2365	2373	2380	2388	2395
23.05	18	26	33	41	48	56	64	71	79	86	94
23.10	17	24	32	39	47	55	62	70	77	85	92
23.15	15	23	30	38	46	53	61	68	76	83	91
23.20	14	21	29	37	44	52	59	67	74	82	90
23.25	12	20	28	35	43	50	58	65	73	80	88
23.30	11	19	26	34	41	49	56	64	71	79	87
23.35	10	17	25	32	40	47	55	62	70	78	85
23.40	08	16	23	31	38	46	53	61	69	76	84
23.45	07	14	22	29	37	44	52	60	67	75	82
23.50	2305	2313	2320	2328	2335	2343	2351	2358	2366	2373	2381
23.55	04	11	19	26	34	41	49	57	64	72	79
23.60	02	10	17	25	32	40	48	55	63	70	78
23.65	01	08	16	23	31	39	46	54	61	69	76
23.70	2299	07	14	22	30	37	45	52	60	67	75
23.75	98	05	13	21	28	36	43	51	58	66	74
23.80	96	04	12	19	27	34	42	49	57	64	72
23.85	95	03	10	18	25	33	40	48	55	63	71
23.90	94	01	09	16	24	31	39	46	54	62	69
23.95	92	00	07	15	22	30	37	45	53	60	68
24.00	2291	2298	2306	2313	2321	2328	2336	2344	2351	2359	2366
24.05	89	97	04	12	19	27	34	42	50	57	65
24.10	88	95	03	10	18	25	33	41	48	56	63
24.15	86	94	01	09	16	24	31	39	47	54	62
24.20	85	92	00	07	15	22	30	38	45	53	60
24.25	83	91	2298	06	13	21	28	36	44	51	59
24.30	82	89	97	04	12	19	27	35	42	50	57
24.35	80	88	95	03	10	18	25	33	41	48	56
24.40	79	86	94	01	09	16	24	32	39	47	54
24.45	77	85	92	00	07	15	22	30	38	45	53
24.50	2276	2283	2291	2298	2306	2313	2321	2329	2336	2344	2351
24.55	74	82	89	97	04	12	19	27	35	42	50
24.60	73	80	88	95	03	10	18	26	33	41	48
24.65	71	79	86	94	01	09	16	24	32	39	47
24.70	70	77	85	92	00	07	15	23	30	38	45
24.75	68	76	83	91	2298	06	13	21	29	36	44
24.80	67	74	82	89	97	04	12	20	27	35	42
24.85	65	73	80	88	95	03	10	18	26	33	41
24.90	64	71	79	86	94	01	09	17	24	32	39
24.95	62	70	77	85	92	00	07	15	23	30	38
25.00	2261	2268	2276	2283	2291	2298	2306	2314	2321	2329	2336
25.05	59	67	74	82	89	97	04	12	20	27	35
25.10	58	65	73	80	88	95	03	10	18	26	33
25.15	56	64	71	79	86	94	01	09	16	24	32
25.20	55	62	70	77	85	92	00	07	15	23	30
25.25	53	61	68	76	83	91	2298	06	13	21	28
25.30	52	59	67	74	82	89	97	04	12	19	27
25.35	50	58	65	73	80	88	95	03	10	18	25
25.40	48	56	64	71	79	86	94	01	09	16	24
25.45	47	54	62	70	77	85	92	00	07	15	22

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem-pera-ture, t	Salinity, S, in $^0/oo$										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
25.50	2245	2253	2261	2268	2276	2283	2291	2298	2306	2313	2321
25.55	44	51	59	67	74	82	89	97	04	12	19
25.60	42	50	57	65	73	80	88	95	03	10	18
25.65	41	48	56	63	71	79	86	94	01	09	16
25.70	39	47	54	62	69	77	85	92	00	07	15
25.75	38	45	53	60	68	75	83	90	2298	06	13
25.80	36	44	51	59	66	74	81	89	97	04	12
25.85	35	42	50	57	65	72	80	87	95	03	10
25.90	33	41	48	56	63	71	78	86	93	01	09
25.95	32	39	47	54	62	69	77	84	92	2299	07
26.00	2230	2238	2245	2253	2260	2268	2275	2283	2290	2298	2305
26.05	29	36	44	51	59	66	74	81	89	96	04
26.10	27	34	42	50	57	65	72	80	87	95	02
26.15	25	33	40	48	55	63	71	78	86	93	01
26.20	24	31	39	46	54	61	69	77	84	92	2299
26.25	22	30	37	45	52	60	67	75	82	90	98
26.30	21	28	36	43	51	58	66	73	81	88	96
26.35	19	27	34	42	49	57	64	72	79	87	94
26.40	18	25	33	40	48	55	63	70	78	85	93
26.45	16	23	31	39	46	54	61	69	76	84	91
26.50	2214	2222	2229	2237	2244	2252	2260	2267	2275	2282	2290
26.55	13	20	28	35	43	50	58	65	73	81	88
26.60	11	19	26	34	41	49	56	64	71	79	87
26.65	10	17	25	32	40	47	55	62	70	77	85
26.70	08	16	23	31	38	46	53	61	68	76	83
26.75	07	14	22	29	37	44	52	59	67	74	82
26.80	05	12	20	28	35	43	50	58	65	73	80
26.85	03	11	18	26	34	41	49	56	64	71	79
26.90	02	09	17	24	32	39	47	54	62	70	77
26.95	00	08	15	23	30	38	45	53	60	68	75
27.00	2199	2206	2214	2221	2229	2236	2244	2251	2259	2266	2274
27.05	97	05	12	20	27	35	42	50	57	65	72
27.10	95	03	10	18	26	33	41	48	56	63	71
27.15	94	01	09	16	24	31	39	46	54	62	69
27.20	92	00	07	15	22	30	37	45	52	60	67
27.25	91	2198	06	13	21	28	36	43	51	58	66
27.30	89	97	04	12	19	27	34	42	49	57	64
27.35	87	95	02	10	17	25	32	40	47	55	63
27.40	86	93	01	08	16	23	31	38	46	53	61
27.45	84	92	2199	07	14	22	29	37	44	52	59
27.50	2183	2190	2198	2205	2213	2220	2228	2235	2243	2250	2258
27.55	81	88	96	03	11	19	26	34	41	49	56
27.60	79	87	94	02	09	17	24	32	39	47	54
27.65	78	85	93	00	08	15	23	30	38	45	53
27.70	76	84	91	2199	06	14	21	29	36	44	51
27.75	74	82	90	97	05	12	20	27	35	42	50
27.80	73	80	88	95	03	10	18	25	33	41	48
27.85	71	79	86	94	01	09	16	24	31	39	46
27.90	70	77	85	92	00	07	15	22	30	37	45
27.95	68	76	83	91	2198	05	13	21	28	36	43
28.00	2166	2174	2181	2189	2196	2204	2212	2219	2227	2234	2242
28.05	65	72	80	87	95	02	10	17	25	32	40
28.10	63	71	78	86	93	01	08	16	23	31	38
28.15	61	69	77	84	92	2199	07	14	22	29	37
28.20	60	67	75	82	90	97	05	12	20	27	35
28.25	58	66	73	81	88	96	03	11	18	26	33
28.30	57	64	72	79	87	94	02	09	17	24	32
28.35	55	62	70	77	85	92	00	07	15	22	30
28.40	53	61	68	76	83	91	2198	06	13	21	28
28.45	52	59	67	74	82	89	97	04	12	19	27
28.50	2150	2157	2165	2172	2180	2187	2195	2202	2210	2218	2225
28.55	48	56	63	71	78	86	93	01	08	16	23
28.60	47	54	62	69	77	84	92	2199	07	14	22
28.65	45	52	60	67	75	83	90	97	05	13	20
28.70	43	51	58	66	73	81	88	96	03	11	18
28.75	42	49	57	64	72	79	87	94	02	09	17
28.80	40	48	55	63	70	78	85	93	00	08	15
28.85	38	46	53	61	68	76	83	91	2198	06	13
28.90	37	44	52	59	67	74	82	89	97	04	12
28.95	35	43	50	58	65	73	80	88	95	03	10

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem-pera-ture, t	Salinity, S, in ‰										
	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0
°											
29.00	2133	2141	2148	2156	2163	2171	2178	2186	2193	2201	2208
29.05	32	39	47	54	62	69	77	84	92	2199	07
29.10	30	38	45	53	60	68	75	83	90	98	05
29.15	28	36	43	51	58	66	73	81	88	96	03
29.20	27	34	42	49	57	64	72	79	87	94	02
29.25	25	32	40	47	55	63	70	77	85	93	00
29.30	23	31	38	46	53	61	68	76	83	91	2198
29.35	22	29	37	44	52	59	67	74	82	89	97
29.40	20	27	35	42	50	57	65	72	80	87	95
29.45	18	26	33	41	48	56	63	71	78	86	93
29.50	2117	2124	2132	2139	2147	2154	2162	2169	2177	2184	2192
29.55	15	22	30	37	45	52	60	67	75	82	90
29.60	13	21	28	36	43	51	58	66	73	81	88
29.65	11	19	26	34	41	49	56	64	71	79	86
29.70	10	17	25	32	40	47	55	62	70	77	85
29.75	08	16	23	31	38	46	53	61	68	76	83
29.80	06	14	21	29	36	44	51	59	66	74	81
29.85	05	12	20	27	35	42	50	57	65	72	80
29.90	03	11	18	26	33	41	48	56	63	71	78
29.95	01	09	16	24	31	39	46	54	61	69	76
30.00	2100	2107	2115	2122	2130	2137	2145	2152	2160	2167	2175

Tem-pera-ture, t	Salinity, S, in ‰										
	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
-2.00	2820	2828	2837	2845	2853	2861	2869	2877	2885	2893	2902
-1.95	20	28	36	45	53	61	69	77	85	93	01
-1.90	20	28	36	44	52	61	69	77	85	93	01
-1.85	20	28	36	44	52	60	69	77	85	93	01
-1.80	20	28	36	44	52	60	68	76	85	93	01
-1.75	19	28	36	44	52	60	68	76	84	93	01
-1.70	19	27	36	44	52	60	68	76	84	92	00
-1.65	19	27	35	44	52	60	68	76	84	92	00
-1.60	19	27	35	43	51	60	68	76	84	92	00
-1.55	19	27	35	43	51	59	67	76	84	92	00
-1.50	2819	2827	2835	2843	2851	2859	2867	2875	2884	2892	2900
-1.45	19	27	35	43	51	59	67	75	83	92	00
-1.40	18	26	35	43	51	59	67	75	83	91	2899
-1.35	18	26	34	43	51	59	67	75	83	91	99
-1.30	18	26	34	42	50	59	67	75	83	91	99
-1.25	18	26	34	42	50	58	67	75	83	91	99
-1.20	18	26	34	42	50	58	66	74	83	91	99
-1.15	18	26	34	42	50	58	66	74	82	90	99
-1.10	17	25	34	42	50	58	66	74	82	90	98
-1.05	17	25	33	42	50	58	66	74	82	90	98
-1.00	2817	2825	2833	2841	2849	2858	2866	2874	2882	2890	2898
-0.95	17	25	33	41	49	57	65	74	82	90	98
-0.90	17	25	33	41	49	57	65	73	81	89	98
-0.85	16	25	33	41	49	57	65	73	81	89	97
-0.80	16	24	32	40	49	57	65	73	81	89	97
-0.75	16	24	32	40	48	56	64	73	81	89	97
-0.70	16	24	32	40	48	56	64	72	80	88	97
-0.65	15	24	32	40	48	56	64	72	80	88	96
-0.60	15	23	31	40	48	56	64	72	80	88	96
-0.55	15	23	31	39	47	55	64	72	80	88	96
-0.50	2815	2823	2831	2839	2847	2855	2863	2871	2879	2888	2896
-0.45	15	23	31	39	47	55	63	71	79	87	95
-0.40	14	22	31	39	47	55	63	71	79	87	95
-0.35	14	22	30	38	46	54	63	71	79	87	95
-0.30	14	22	30	38	46	54	62	70	78	87	95
-0.25	14	22	30	38	46	54	62	70	78	86	94
-0.20	13	22	30	38	46	54	62	70	78	86	94
-0.15	13	21	29	37	46	54	62	70	78	86	94
-0.10	13	21	29	37	45	53	61	69	78	86	94
-0.05	13	21	29	37	45	53	61	69	77	85	93

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Temperature, t	Salinity, S, in ‰										
	35.0	35.1	35.2	25.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
° 0.00	2813	2821	2829	2837	2845	2853	2861	2869	2877	2885	2893
0.05	12	20	28	36	44	53	61	69	77	85	93
0.10	12	20	28	36	44	52	60	68	76	84	93
0.15	12	20	28	36	44	52	60	68	76	84	92
0.20	11	19	27	36	44	52	60	68	76	84	92
0.25	11	19	27	35	43	51	59	67	76	84	92
0.30	11	19	27	35	43	51	59	67	75	83	91
0.35	10	18	27	35	43	51	59	67	75	83	91
0.40	10	18	26	34	42	50	58	66	75	83	91
0.45	10	18	26	34	42	50	58	66	74	82	90
0.50	2810	2818	2826	2834	2842	2850	2858	2866	2874	2882	2890
0.55	09	17	25	33	41	50	58	66	74	82	90
0.60	09	17	25	33	41	49	57	65	73	81	89
0.65	09	17	25	33	41	49	57	65	73	81	89
0.70	08	16	24	32	41	49	57	65	73	81	89
0.75	08	16	24	32	40	48	56	64	72	80	88
0.80	08	16	24	32	40	48	56	64	72	80	88
0.85	07	15	24	32	40	48	56	64	72	80	88
0.90	07	15	23	31	39	47	55	63	71	80	88
0.95	07	15	23	31	39	47	55	63	71	79	87
1.00	2807	2815	2823	2831	2839	2847	2855	2863	2871	2879	2887
1.05	06	14	22	30	38	46	54	62	70	78	86
1.10	06	14	22	30	38	46	54	62	70	78	86
1.15	05	13	22	30	38	46	54	62	70	78	86
1.20	05	13	21	29	37	45	53	61	69	77	85
1.25	05	13	21	29	37	45	53	61	69	77	85
1.30	04	12	20	28	36	45	53	61	69	77	85
1.35	04	12	20	28	36	44	52	60	68	76	84
1.40	04	12	20	28	36	44	52	60	68	76	84
1.45	03	11	19	27	35	43	51	59	67	75	83
1.50	2803	2811	2819	2827	2835	2843	2851	2859	2867	2875	2883
1.55	03	11	19	27	35	43	51	59	67	75	83
1.60	02	10	18	26	34	42	50	58	66	74	82
1.65	02	10	18	26	34	42	50	58	66	74	82
1.70	01	09	17	26	34	42	50	58	66	74	82
1.75	01	09	17	25	33	41	49	57	65	73	81
1.80	01	09	17	25	33	41	49	57	65	73	81
1.85	00	08	16	24	32	40	48	56	64	72	80
1.90	00	08	16	24	32	40	48	56	64	72	80
1.95	00	08	16	24	32	40	48	56	64	72	80
2.00	2799	2807	2815	2823	2831	2839	2847	2855	2863	2871	2879
2.05	99	07	15	23	31	39	47	55	63	71	79
2.10	98	06	14	22	30	38	46	54	62	70	78
2.15	98	06	14	22	30	38	46	54	62	70	78
2.20	98	06	14	22	30	38	46	54	62	70	78
2.25	97	05	13	21	29	37	45	53	61	69	77
2.30	97	05	13	21	29	37	45	53	61	69	77
2.35	96	04	12	20	28	36	44	52	60	68	76
2.40	96	04	12	20	28	36	44	52	60	68	76
2.45	95	03	11	19	27	35	43	51	59	67	75
2.50	2795	2803	2811	2819	2827	2835	2843	2851	2859	2867	2875
2.55	94	02	10	18	26	34	42	50	58	66	74
2.60	94	02	10	18	26	34	42	50	58	66	74
2.65	94	02	10	18	26	34	41	49	57	65	73
2.70	93	01	09	17	25	33	41	49	57	65	73
2.75	93	01	09	17	25	33	41	49	57	65	73
2.80	92	00	08	16	24	32	40	48	56	64	72
2.85	92	00	08	16	24	32	40	48	56	64	72
2.90	91	2799	07	15	23	31	39	47	55	63	71
2.95	91	99	07	15	23	31	39	47	55	63	71
3.00	2791	2799	2807	2815	2823	2830	2838	2846	2854	2862	2870
3.05	90	98	06	14	22	30	38	46	54	62	70
3.10	90	98	06	14	22	29	37	45	53	61	69
3.15	89	97	05	13	21	29	37	45	53	61	69
3.20	89	97	05	13	21	28	36	44	52	60	68
3.25	88	96	04	12	20	28	36	44	52	60	68
3.30	88	96	04	12	20	27	35	43	51	59	67
3.35	87	95	03	11	19	27	35	43	51	59	67
3.40	87	95	03	11	19	26	34	42	50	58	66
3.45	86	94	02	10	18	26	34	42	50	58	66

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Temperature, t	Salinity, S, in $^0/oo$										
	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
3.50	2786	2794	2802	2810	2818	2825	2833	2841	2849	2857	2865
3.55	85	93	01	09	17	25	33	41	49	57	65
3.60	85	93	01	09	17	24	32	40	48	56	64
3.65	84	92	00	08	16	24	32	40	48	56	64
3.70	84	92	00	08	16	23	31	39	47	55	63
3.75	83	91	2799	07	15	23	31	39	47	55	63
3.80	83	91	99	07	15	22	30	38	46	54	62
3.85	82	90	98	06	14	22	30	38	46	54	62
3.90	82	90	98	06	14	21	29	37	45	53	61
3.95	81	89	97	05	13	21	29	37	45	53	61
4.00	2781	2789	2797	2805	2813	2820	2828	2836	2844	2852	2860
4.05	80	88	96	04	12	20	28	36	44	52	60
4.10	80	88	96	03	11	19	27	35	43	51	59
4.15	79	87	95	03	11	19	27	35	43	50	58
4.20	79	86	94	02	10	18	26	34	42	50	58
4.25	78	86	94	02	10	18	26	33	41	49	57
4.30	77	85	93	01	09	17	25	33	41	49	57
4.35	77	85	93	01	09	16	24	32	40	48	56
4.40	76	84	92	00	08	16	24	32	40	48	56
4.45	76	84	92	00	07	15	23	31	39	47	55
4.50	2775	2783	2791	2799	2807	2815	2823	2831	2839	2847	2855
4.55	75	82	90	98	06	14	22	30	38	46	54
4.60	74	82	90	98	06	14	22	30	38	45	53
4.65	73	81	89	97	05	13	21	29	37	45	53
4.70	73	81	89	97	05	13	21	28	36	44	52
4.75	72	80	88	96	04	12	20	28	36	44	52
4.80	72	80	88	96	04	11	19	27	35	43	51
4.85	71	79	87	95	03	11	19	27	35	43	50
4.90	71	79	87	94	02	10	18	26	34	42	50
4.95	70	78	86	94	02	10	18	26	33	41	49
5.00	2770	2778	2785	2793	2801	2809	2817	2825	2833	2841	2849
5.05	69	77	85	93	01	09	16	24	32	40	48
5.10	68	76	84	92	00	08	16	24	32	40	48
5.15	68	76	84	91	2799	07	15	23	31	39	47
5.20	67	75	83	91	99	07	15	23	30	38	46
5.25	66	74	82	90	98	06	14	22	30	38	46
5.30	66	74	82	90	98	05	13	21	29	37	45
5.35	65	73	81	89	97	05	13	21	29	36	44
5.40	65	73	81	88	96	04	12	20	28	36	44
5.45	64	72	80	88	96	04	12	19	27	35	43
5.50	2763	2771	2779	2787	2795	2803	2811	2819	2827	2835	2843
5.55	63	71	79	87	94	02	10	18	26	34	42
5.60	62	70	78	86	94	02	10	18	25	33	41
5.65	62	69	77	85	93	01	09	17	25	33	41
5.70	61	69	77	85	93	01	08	16	24	32	40
5.75	60	68	76	84	92	00	08	16	24	31	39
5.80	60	68	76	83	91	2799	07	15	23	31	39
5.85	59	67	75	83	91	99	07	14	22	30	38
5.90	59	66	74	82	90	98	06	14	22	30	38
5.95	58	66	74	82	89	97	05	13	21	29	37
6.00	2757	2765	2773	2781	2789	2797	2805	2813	2820	2828	2836
6.05	57	64	72	80	88	96	04	12	20	28	36
6.10	56	64	72	80	88	95	03	11	19	27	35
6.15	55	63	71	79	87	95	03	10	18	26	34
6.20	55	63	70	78	86	94	02	10	18	26	34
6.25	54	62	70	78	85	93	01	09	17	25	33
6.30	53	61	69	77	85	93	01	08	16	24	32
6.35	53	60	68	76	84	92	00	08	16	24	31
6.40	52	60	68	76	83	91	2799	07	15	23	31
6.45	51	59	67	74	83	91	99	06	14	22	30
6.50	2751	2758	2766	2774	2782	2790	2798	2806	2814	2822	2829
6.55	50	58	66	74	81	89	97	05	13	21	29
6.60	49	57	65	73	81	89	97	04	12	20	28
6.65	49	56	64	72	80	88	96	04	12	19	27
6.70	48	56	64	72	79	87	95	03	11	19	27
6.75	47	55	63	71	79	87	94	02	10	18	26
6.80	47	54	62	70	78	86	94	10	10	17	25
6.85	46	54	62	69	77	85	93	01	09	17	25
6.90	45	53	61	69	77	85	92	00	08	16	24
6.95	45	52	60	68	76	84	92	00	07	15	23

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Temperature, t	Salinity, S, in ⁰/oo 35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
7.00	2744	2752	2760	2768	2775	2783	2791	2799	2807	2815	2823
7.05	43	51	59	67	75	82	90	98	06	14	22
7.10	42	50	58	66	74	82	90	98	05	13	21
7.15	42	50	57	65	73	81	89	97	05	12	20
7.20	41	49	57	65	72	80	88	96	04	12	20
7.25	40	48	56	64	72	80	87	95	03	11	19
7.30	40	47	55	63	71	79	87	95	02	10	18
7.35	39	47	54	62	70	78	86	94	02	10	17
7.40	38	46	54	62	70	77	85	93	01	09	17
7.45	37	45	53	61	69	77	84	92	00	08	16
7.50	2737	2744	2752	2760	2768	2776	2784	2792	2799	2807	2815
7.55	36	44	52	59	67	75	83	91	99	07	14
7.60	35	43	51	59	67	74	82	90	98	06	14
7.65	34	42	50	58	66	74	82	89	97	05	13
7.70	34	42	49	57	65	73	81	89	97	04	12
7.75	33	41	49	56	64	72	80	88	96	04	11
7.80	32	40	48	56	64	72	79	87	95	03	11
7.85	31	39	47	55	63	71	79	86	94	02	10
7.90	31	39	47	54	62	70	78	86	94	01	09
7.95	30	38	46	54	61	69	77	85	93	01	09
8.00	2729	2737	2745	2753	2761	2769	2776	2784	2792	2800	2808
8.05	29	36	44	52	60	68	76	83	91	2799	07
8.10	28	36	43	51	59	67	75	83	91	98	06
8.15	27	35	43	50	58	66	74	82	90	98	05
8.20	26	34	42	50	58	65	73	81	89	97	05
8.25	25	33	41	49	57	65	72	80	88	96	04
8.30	25	33	40	48	56	64	72	80	87	95	03
8.35	24	32	40	47	55	63	71	79	87	94	02
8.40	23	31	39	47	54	62	70	78	86	94	01
8.45	22	30	38	46	54	61	69	77	85	93	01
8.50	2722	2729	2737	2745	2753	2761	2769	2776	2784	2792	2800
8.55	21	29	36	44	52	60	68	76	83	91	2799
8.60	20	28	36	43	51	59	67	75	83	90	98
8.65	19	27	35	43	50	58	66	74	82	90	97
8.70	18	26	34	42	50	58	65	73	81	89	97
8.75	18	25	33	41	49	57	65	72	80	88	96
8.80	17	25	33	40	48	56	64	72	79	87	95
8.85	16	24	32	39	47	55	63	71	79	86	94
8.90	15	23	31	39	47	54	62	70	78	86	94
8.95	14	22	30	38	46	54	61	69	77	85	93
9.00	2714	2722	2729	2737	2745	2753	2761	2768	2776	2784	2792
9.05	13	21	29	36	44	52	60	68	75	83	91
9.10	12	20	28	36	43	51	59	67	75	82	90
9.15	11	19	27	35	42	50	58	66	74	82	89
9.20	10	18	26	34	42	49	57	65	73	81	89
9.25	10	17	25	33	41	49	56	64	72	80	88
9.30	09	17	24	32	40	48	56	63	71	79	87
9.35	08	16	24	31	39	47	55	63	70	78	86
9.40	07	15	23	31	38	46	54	62	70	77	85
9.45	06	14	22	30	37	45	53	61	69	76	84
9.50	2705	2713	2721	2729	2737	2744	2752	2760	2768	2776	2784
9.55	05	12	20	28	36	44	51	59	67	75	83
9.60	04	12	19	27	35	43	51	58	66	74	82
9.65	03	11	18	26	34	42	50	58	65	73	81
9.70	02	10	18	25	33	41	49	57	65	72	80
9.75	01	09	17	25	32	40	48	56	64	72	79
9.80	00	08	16	24	32	39	47	55	63	71	78
9.85	00	07	15	23	31	39	46	54	62	70	78
9.90	2699	07	14	22	30	38	46	53	61	69	77
9.95	98	06	13	21	29	37	45	52	60	68	76
10.00	2697	2705	2713	2720	2728	2736	2744	2752	2759	2767	2775
10.05	96	04	12	20	27	35	43	51	59	66	74
10.10	95	03	11	19	27	34	42	50	58	65	73
10.15	94	02	10	18	26	33	41	49	57	65	72
10.20	94	01	09	17	25	33	40	48	56	64	71
10.25	93	00	08	16	24	32	39	47	55	63	71
10.31	92	00	07	15	23	31	39	46	54	62	70
10.35	91	2699	06	14	22	30	38	45	53	61	69
10.40	90	98	06	13	21	29	37	45	52	60	68
10.45	89	97	05	12	20	28	36	44	51	59	67

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Temperature, t	Salinity, S, in $^{0}/oo$										
	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
10.50	2688	2696	2704	2712	2719	2727	2735	2743	2751	2758	2766
10.55	87	95	03	11	18	26	34	42	50	57	65
10.60	86	94	02	10	18	25	33	41	49	57	64
10.65	86	93	01	09	17	24	32	40	48	56	63
10.70	85	93	00	08	16	24	31	39	47	55	63
10.75	84	92	2699	07	15	23	30	38	46	54	62
10.80	83	91	99	06	14	22	30	37	45	53	61
10.85	82	90	98	05	13	21	29	36	44	52	60
10.90	81	89	97	06	12	20	28	36	43	51	59
10.95	80	88	96	04	11	19	27	35	42	50	58
11.00	2679	2687	2695	2703	2711	2718	2726	2734	2742	2749	2757
11.05	78	86	94	02	10	17	25	33	41	48	56
11.10	78	85	93	01	09	16	24	32	40	48	55
11.15	77	84	92	00	08	15	23	31	39	47	54
11.20	76	83	91	2699	07	15	22	30	38	46	53
11.25	75	82	90	98	06	14	21	29	37	45	52
11.30	74	82	89	97	05	13	20	28	36	44	52
11.35	73	81	88	96	04	12	19	27	35	43	51
11.40	72	80	87	95	03	11	19	26	34	42	50
11.45	71	79	86	94	02	10	18	25	33	41	49
11.50	2670	2678	2686	2693	2701	2709	2717	2724	2732	2740	2748
11.55	69	77	85	92	00	08	16	23	31	39	47
11.60	68	76	84	91	2699	07	15	23	30	38	46
11.65	67	75	83	90	98	06	14	22	29	37	45
11.70	66	74	82	90	97	05	13	21	28	36	44
11.75	65	73	81	89	96	04	12	20	27	35	43
11.80	64	72	80	88	96	03	11	19	27	34	42
11.85	63	71	79	87	95	02	10	18	26	33	41
11.90	63	70	78	86	94	01	09	17	25	32	40
11.95	62	69	77	85	93	00	08	16	24	31	39
12.00	2661	2668	2676	2684	2692	2700	2707	2715	2723	2731	2738
12.05	60	67	75	83	91	99	06	14	22	30	37
12.10	59	67	74	82	90	98	05	13	21	29	36
12.15	58	66	73	81	89	97	04	12	20	28	35
12.20	57	65	72	80	88	96	03	11	19	27	34
12.25	56	64	71	79	87	95	02	10	18	26	33
12.30	55	63	70	78	86	94	01	09	17	25	32
12.35	54	62	69	77	85	93	00	08	16	24	31
12.40	53	61	68	76	84	92	2699	07	15	23	30
12.45	52	60	67	75	83	91	98	06	14	22	29
12.50	2651	2659	2666	2674	2682	2690	2697	2705	2713	2721	2728
12.55	50	58	65	73	81	89	96	04	12	20	27
12.60	49	57	64	72	80	88	95	03	11	19	26
12.65	48	56	63	71	79	87	94	02	10	18	25
12.70	47	55	62	70	78	86	93	01	09	17	24
12.75	46	54	61	69	77	85	92	00	08	16	23
12.80	45	53	60	68	76	84	91	2699	07	15	22
12.85	44	52	59	67	75	83	90	98	06	14	21
12.90	43	51	59	66	74	82	89	97	05	13	20
12.95	42	50	58	65	73	81	88	96	04	12	19
13.00	2641	2649	2657	2664	2672	2680	2687	2695	2703	2711	2718
13.05	40	48	55	63	71	79	86	94	02	10	17
13.10	39	47	54	62	70	78	85	93	01	09	16
13.15	38	46	53	61	69	77	84	92	00	08	15
13.20	37	45	52	60	68	76	83	91	2699	07	14
13.25	36	44	51	59	67	75	82	90	98	05	13
13.30	35	43	50	58	66	74	81	89	97	04	12
13.35	34	42	49	57	65	72	80	88	96	03	11
13.40	33	41	48	56	64	71	79	87	95	02	10
13.45	32	40	47	55	63	70	78	86	94	01	09
13.50	2631	2639	2646	2654	2662	2669	2677	2685	2693	2700	2708
13.55	30	37	45	53	61	68	76	84	91	2699	07
13.60	29	36	44	52	60	67	75	83	91	98	06
13.65	28	35	43	51	59	66	74	82	89	97	05
13.70	27	34	42	50	58	65	73	81	88	96	04
13.75	26	33	41	49	56	64	72	80	87	95	03
13.80	25	32	40	48	55	63	71	79	86	94	02
13.85	24	31	39	47	54	62	70	78	85	93	01
13.90	23	30	38	46	53	61	69	77	84	92	00
13.95	21	29	37	45	52	60	68	76	83	91	2699

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem-pera-ture, t	Salinity, S, in ^{0}/oo										
	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
14.00	2620	2628	2636	2644	2651	2659	2667	2674	2682	2690	2698
14.05	19	27	35	43	50	58	66	73	81	89	97
14.10	18	26	34	41	49	57	65	72	80	88	95
14.15	17	25	33	40	48	56	63	71	79	87	94
14.20	16	24	32	39	47	55	62	70	78	86	93
14.25	15	23	30	38	46	54	61	69	77	84	92
14.30	14	22	29	37	45	53	60	68	76	83	91
14.35	13	21	28	35	44	51	59	67	75	82	90
14.40	12	20	27	35	43	50	58	66	74	81	89
14.45	11	18	26	34	42	49	57	65	72	80	88
14.50	2610	2617	2625	2633	2641	2648	2656	2664	2671	2679	2687
14.55	09	16	24	32	39	47	55	63	70	78	86
14.60	08	15	23	31	38	46	54	62	69	77	85
14.65	06	14	22	30	37	45	53	60	68	76	83
14.70	05	13	21	29	36	44	52	59	67	75	82
14.75	04	12	20	27	35	43	51	58	66	74	81
14.80	03	11	19	26	34	42	49	57	65	73	80
14.85	02	10	18	25	33	41	48	56	64	71	79
14.90	01	09	17	24	32	40	47	55	63	70	78
14.95	01	08	15	23	31	39	46	54	62	69	77
15.00	2599	2607	2614	2622	2630	2637	2645	2653	2661	2668	2676
15.05	98	06	13	21	29	36	44	52	59	67	75
15.10	97	04	12	20	28	35	43	51	58	66	74
15.15	96	03	11	19	26	34	42	49	57	65	73
15.20	95	02	10	18	25	33	41	48	56	64	71
15.25	93	01	09	16	24	32	39	47	55	63	70
15.30	92	00	08	15	23	31	38	46	54	61	69
15.35	91	2599	06	14	22	30	37	45	53	60	68
15.40	90	98	05	13	21	28	36	44	52	59	67
15.45	89	97	04	12	20	27	35	43	50	58	66
15.50	2588	2595	2603	2611	2619	2626	2634	2642	2649	2657	2665
15.55	87	94	02	10	17	25	33	40	48	56	64
15.60	86	93	01	09	16	24	32	39	47	55	62
15.65	84	92	00	07	15	23	30	38	46	53	61
15.70	83	91	2599	06	14	22	29	37	45	52	60
15.75	82	90	97	05	13	21	28	36	44	51	59
15.80	81	89	96	04	12	19	27	35	42	50	58
15.85	80	88	95	03	11	18	26	34	41	49	57
15.90	79	86	94	02	10	17	25	33	40	48	56
15.95	78	85	93	01	08	16	24	31	39	47	54
16.00	2577	2584	2592	2600	2607	2615	2623	2630	2638	2646	2653
16.05	75	83	91	2598	06	14	21	29	37	45	52
16.10	74	82	90	97	05	13	20	28	36	43	51
16.15	73	81	88	96	04	11	19	27	34	42	50
16.20	72	80	87	95	03	10	18	26	33	41	49
16.25	71	78	86	94	01	09	17	24	32	40	47
16.30	70	77	85	93	00	08	16	23	31	39	46
16.35	68	76	84	91	2599	07	14	22	30	37	45
16.40	67	75	83	90	98	06	13	21	29	36	44
16.45	66	74	81	89	97	04	12	20	27	35	43
16.50	2565	2573	2580	2588	2596	2603	2611	2619	2626	2634	2642
16.55	64	71	79	87	94	02	10	17	25	33	40
16.60	63	70	78	86	93	01	09	16	24	32	39
16.65	61	69	77	84	92	00	07	15	23	30	38
16.70	60	68	76	83	91	2599	06	14	22	29	37
16.75	59	67	74	82	90	97	05	13	20	28	36
16.80	58	66	73	81	89	96	04	12	19	27	35
16.85	57	64	72	80	87	95	03	10	18	26	33
16.90	56	63	71	79	86	94	02	09	17	25	32
16.95	54	62	70	77	85	93	00	08	16	23	31
17.00	2553	2561	2569	2576	2584	2592	2599	2607	2614	2622	2630
17.05	52	60	67	75	83	90	98	06	13	21	29
17.10	51	58	66	74	81	89	97	04	12	20	27
17.15	50	57	65	73	80	88	96	03	11	19	26
17.20	48	56	64	71	79	87	94	02	10	17	25
17.25	47	55	62	70	78	85	93	01	08	16	24
17.30	46	54	61	69	77	84	92	00	07	15	23
17.35	45	52	60	68	75	83	91	2598	06	14	21
17.40	44	51	59	67	74	82	89	97	05	12	20
17.45	42	50	58	65	73	81	88	96	04	11	19

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem- pera- ture, t	Salinity, S, in $^0/oo$										
	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
17.50	2541	2549	2556	2564	2572	2579	2587	2595	2602	2610	2618
17.55	40	48	55	63	71	78	86	93	01	09	16
17.60	39	46	54	62	69	77	85	92	00	08	15
17.65	37	45	53	60	68	76	83	91	2599	06	14
17.70	36	44	52	59	67	75	82	90	97	05	13
17.75	35	43	50	58	66	73	81	89	96	04	12
17.80	34	42	49	57	64	72	80	87	95	03	10
17.85	33	40	48	56	63	71	78	86	94	01	09
17.90	31	39	47	54	62	70	77	85	93	00	08
17.95	30	38	46	53	61	69	76	84	91	2599	07
18.00	2529	2537	2544	2552	2560	2567	2575	2583	2590	2598	2605
18.05	28	35	43	51	58	66	74	81	89	97	04
18.10	27	34	42	49	57	65	72	80	88	95	03
18.15	25	33	41	48	56	64	71	79	86	94	02
18.20	24	32	39	47	55	62	70	78	85	93	00
18.25	23	30	38	46	53	61	69	76	84	92	2599
18.30	22	29	37	44	52	60	67	75	83	90	98
18.35	20	28	36	43	51	58	66	74	81	89	97
18.40	19	27	34	42	50	57	65	72	80	88	95
18.45	18	25	33	41	48	56	64	71	79	86	94
18.50	2516	2524	2532	2539	2547	2555	2562	2570	2578	2585	2593
18.55	15	23	30	38	46	53	61	69	76	84	92
18.60	14	22	29	37	45	52	60	67	75	83	90
18.65	13	20	28	36	43	51	58	66	74	81	89
18.70	11	19	27	34	42	50	57	65	73	80	88
18.75	10	18	25	33	41	48	56	64	71	79	87
18.80	09	17	24	32	40	47	55	62	70	78	85
18.85	08	15	23	31	38	46	53	61	69	76	84
18.90	06	14	22	29	37	45	52	60	67	75	83
18.95	05	13	20	28	36	43	51	59	66	74	81
19.00	2504	2512	2519	2527	2534	2542	2550	2557	2565	2573	2580
19.05	03	10	18	26	33	41	48	56	64	71	79
19.10	01	09	17	24	32	39	47	55	62	70	78
19.15	00	08	15	23	31	38	46	53	61	69	76
19.20	2499	06	14	22	29	37	45	52	60	67	75
19.25	98	05	13	20	28	36	43	51	58	66	74
19.30	96	04	11	19	27	34	42	50	57	65	72
19.35	95	03	10	18	25	33	41	48	56	64	71
19.40	94	01	09	16	24	32	39	47	55	62	70
19.45	92	00	08	15	23	30	38	46	53	61	68
19.50	2491	2499	2506	2514	2521	2529	2537	2544	2552	2560	2567
19.55	90	97	05	13	20	28	35	43	51	58	66
19.60	88	96	04	11	19	27	34	42	49	57	65
19.65	87	95	02	10	18	25	33	40	48	56	63
19.70	86	93	01	09	16	24	32	39	47	54	62
19.75	85	92	00	07	15	23	30	38	45	53	61
19.80	83	91	2498	06	14	21	29	37	44	52	59
19.85	82	90	97	05	12	20	28	35	43	51	58
19.90	81	88	96	03	11	19	26	34	42	49	57
19.95	79	87	95	02	10	17	25	33	40	48	56
20.00	2478	2486	2493	2501	2509	2516	2524	2531	2539	2547	2554
20.05	77	84	92	00	07	15	22	30	38	45	53
20.10	75	83	91	2498	06	13	21	29	36	44	51
20.15	74	82	89	97	04	12	20	27	35	43	50
20.20	73	80	88	96	03	11	18	26	34	41	49
20.25	71	79	87	94	02	09	17	25	32	40	47
20.30	70	78	85	93	00	08	16	23	31	38	46
20.35	69	76	84	92	2499	07	14	22	30	37	45
20.40	67	75	83	90	98	05	13	21	28	36	43
20.45	66	74	81	89	96	04	12	19	27	34	42
20.50	2465	2472	2480	2488	2495	2503	2510	2518	2526	2533	2541
20.55	63	71	79	86	94	01	09	17	24	32	39
20.60	62	70	77	85	92	00	08	15	23	30	38
20.65	61	68	76	83	91	2499	06	14	21	29	37
20.70	59	67	75	82	90	97	05	13	20	28	35
20.75	58	66	73	81	88	96	04	11	19	26	34
20.80	57	64	72	79	87	95	02	10	17	25	33
20.85	55	63	71	78	86	93	01	09	16	24	31
20.90	54	62	69	77	84	92	00	07	15	22	30
20.95	53	60	68	75	83	91	2498	06	13	21	29

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Tem-pera-ture, t	Salinity, S, in ‰										
	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
21.00	2451	2459	2467	2474	2482	2489	2497	2504	2512	2520	2527
21.05	50	58	65	73	80	88	96	03	11	18	26
21.10	49	56	64	71	79	87	94	02	09	17	25
21.15	47	55	62	70	78	85	93	00	08	16	23
21.20	46	53	61	69	76	84	91	2499	07	14	22
21.25	44	52	60	67	75	82	90	98	05	13	20
21.30	43	51	58	66	73	81	89	96	04	11	19
21.35	42	49	57	64	72	80	87	95	02	10	18
21.40	40	48	55	63	71	78	86	93	01	09	16
21.45	39	46	54	62	69	77	84	92	00	07	15
21.50	2438	2445	2453	2460	2468	2475	2483	2491	2498	2506	2513
21.55	36	44	51	59	67	74	82	89	97	04	12
21.60	35	42	50	58	65	73	80	88	95	03	11
21.65	33	41	49	56	64	71	79	86	94	02	09
21.70	32	40	47	55	62	70	78	85	93	00	08
21.75	31	38	46	53	61	69	76	84	91	2499	07
21.80	29	37	44	52	60	67	75	82	90	98	05
21.85	28	35	43	51	58	66	73	81	89	96	04
21.90	26	34	42	49	57	64	72	80	87	95	02
21.95	25	33	40	48	55	63	71	78	86	93	01
22.00	2424	2431	2439	2446	2454	2462	2469	2477	2484	2492	2500
22.05	22	30	37	45	53	60	68	75	83	91	2498
22.10	21	28	36	44	51	59	66	74	82	89	97
22.15	19	27	35	42	50	57	65	73	80	88	95
22.20	18	26	33	41	48	56	64	71	79	86	94
22.25	17	24	32	39	47	55	62	70	77	85	92
22.30	15	23	30	38	46	53	61	68	76	83	91
22.35	14	21	29	37	44	52	59	67	74	82	90
22.40	12	20	28	35	43	50	58	65	73	81	88
22.45	11	19	26	34	41	49	56	64	72	79	87
22.50	2410	2417	2425	2432	2440	2447	2455	2463	2470	2478	2485
22.55	08	16	23	31	38	46	54	61	69	76	84
22.60	07	14	22	29	37	45	52	60	67	75	82
22.65	05	13	20	28	36	43	51	58	66	73	81
22.70	04	11	19	27	34	42	49	57	64	72	80
22.75	02	10	18	25	33	40	48	56	63	71	78
22.80	01	09	16	24	31	39	46	54	62	69	77
22.85	00	07	15	22	30	37	45	53	60	68	75
22.90	2398	06	13	21	28	36	44	51	59	66	74
22.95	97	04	12	20	27	35	42	50	57	65	73
23.00	2395	2403	2410	2418	2426	2433	2441	2448	2456	2463	2471
23.05	94	01	09	17	24	32	39	47	54	62	70
23.10	92	00	08	15	23	30	38	45	53	61	68
23.15	91	2399	06	14	21	29	36	44	52	59	67
23.20	90	97	05	12	20	27	35	42	50	58	65
23.25	88	96	03	11	18	26	33	41	49	56	64
23.30	87	94	02	09	17	24	32	40	47	55	62
23.35	85	93	00	08	15	23	31	38	46	53	61
23.40	84	91	2399	06	14	22	29	37	44	52	59
23.45	82	90	97	05	12	20	28	35	43	50	58
23.50	2381	2388	2396	2403	2411	2419	2426	2434	2441	2449	2456
23.55	79	87	94	02	10	17	25	32	40	47	55
23.60	78	85	93	01	08	16	23	31	38	46	53
23.65	76	84	92	2399	07	14	22	29	37	44	52
23.70	75	82	90	98	05	13	20	28	35	43	51
23.75	73	81	89	96	04	11	19	26	34	42	49
23.80	72	80	87	95	02	10	17	25	32	40	48
23.85	71	78	86	93	01	08	16	23	31	39	46
23.90	69	77	84	92	2399	07	14	22	30	37	45
23.95	68	75	83	90	98	05	13	21	28	36	43
24.00	2366	2374	2381	2389	2396	2404	2412	2419	2427	2434	2442
24.05	65	72	80	87	95	02	10	18	25	33	40
24.10	63	71	78	86	93	01	09	16	24	31	39
24.15	62	69	77	84	92	2399	07	15	22	30	37
24.20	60	68	75	83	90	98	06	13	21	28	36
24.25	59	66	74	81	89	96	04	12	19	27	34
24.30	57	65	72	80	87	95	03	10	18	25	33
24.35	56	63	71	78	86	93	01	09	16	24	31
24.40	54	62	69	77	84	92	00	07	15	22	30
24.45	53	60	68	75	83	90	2398	05	13	21	28

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Continued

Temperature, t	Salinity, S, in ⁰/oo										
	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
24.50	2351	2359	2366	2374	2381	2389	2396	2404	2412	2419	2427
24.55	50	57	65	72	80	87	95	03	10	18	25
24.60	48	56	63	71	78	86	93	01	09	16	24
24.65	47	54	62	69	77	84	92	00	07	15	22
24.70	45	53	60	68	75	83	90	2398	06	13	21
24.75	44	51	59	66	74	81	89	97	04	12	19
24.80	42	50	57	65	72	80	87	95	03	10	18
24.85	41	48	56	63	71	78	86	94	01	09	16
24.90	39	47	54	62	69	77	84	92	00	07	15
24.95	38	44	53	60	68	75	83	91	2398	06	13
25.00	2336	2344	2351	2359	2366	2374	2381	2389	2397	2404	2412
25.05	35	42	50	57	65	72	80	87	95	03	10
25.10	33	41	48	56	63	71	78	86	93	01	09
25.15	32	39	47	54	62	69	77	84	92	2399	07
25.20	30	38	45	53	60	68	75	83	90	98	05
25.25	28	36	44	51	59	66	74	81	89	96	04
25.30	27	35	42	50	57	65	72	80	87	95	02
25.35	25	33	41	48	56	63	71	78	86	93	01
25.40	24	31	39	47	54	62	69	77	84	92	2399
25.45	22	30	37	45	53	60	68	75	83	90	98
25.50	2321	2328	2336	2343	2351	2359	2366	2374	2381	2389	2396
25.55	19	27	34	42	49	57	65	72	80	87	95
25.60	18	25	33	40	48	55	63	71	78	86	93
25.65	16	24	31	39	46	54	61	69	77	84	92
25.70	15	22	30	37	45	52	60	67	75	83	90
25.75	13	21	28	35	43	51	58	66	73	81	88
25.80	12	19	27	34	42	49	57	64	72	79	87
25.85	10	18	25	33	40	48	55	63	70	78	85
25.90	09	16	24	31	39	46	54	61	69	76	84
25.95	07	15	22	30	37	45	52	60	67	75	82
26.00	2305	2313	2321	2328	2336	2343	2351	2358	2366	2373	2381
26.05	04	11	19	26	34	42	49	57	64	72	79
26.10	02	10	17	25	32	40	47	55	63	70	78
26.15	01	08	16	23	31	38	46	53	61	68	76
26.20	2299	07	14	22	29	37	44	52	59	67	74
26.25	98	05	13	20	28	35	43	50	58	65	73
26.30	96	04	11	19	26	34	41	49	56	64	71
26.35	94	02	09	17	25	32	40	47	55	62	70
26.40	93	00	08	15	23	30	38	46	53	61	68
26.45	91	2299	06	14	21	29	36	44	51	59	67
26.50	2290	2297	2305	2312	2320	2327	2335	2342	2350	2357	2365
26.55	88	96	03	11	18	26	33	41	48	56	63
26.60	87	94	02	09	17	24	32	39	47	54	62
26.65	85	92	00	08	15	23	30	38	45	53	60
26.70	83	91	2298	06	13	21	29	36	44	51	59
26.75	82	89	97	04	12	19	27	34	42	50	57
26.80	80	88	95	03	10	18	25	33	40	48	55
26.85	79	86	94	01	09	16	24	31	39	46	54
26.90	77	85	92	00	07	15	22	30	37	45	52
26.95	75	83	90	2298	06	13	21	28	36	43	51
27.00	2274	2281	2289	2296	2304	2312	2319	2327	2334	2342	2349
27.05	72	80	87	95	02	10	17	25	32	40	47
27.10	71	78	86	93	01	08	16	23	31	38	46
27.15	69	77	84	92	2299	07	14	22	29	37	44
27.20	67	75	82	90	98	05	13	20	28	35	42
27.25	66	73	81	88	96	03	11	18	26	34	41
27.30	64	72	79	87	94	02	09	17	24	32	39
27.35	63	70	78	85	93	00	08	15	23	30	38
27.40	61	68	76	84	91	2299	06	14	21	29	36
27.45	59	67	74	82	89	97	04	12	20	27	35
27.50	2258	2265	2273	2280	2288	2295	2303	2310	2318	2325	2333
27.55	56	64	71	79	86	94	01	09	16	24	31
27.60	54	62	70	77	85	92	00	07	15	22	30
27.65	53	60	68	75	83	90	2298	06	13	21	28
27.70	51	59	66	74	81	89	96	04	11	19	26
27.75	50	57	65	72	80	87	95	02	10	17	25
27.80	48	56	63	71	78	86	93	01	08	16	23
27.85	46	54	62	69	76	84	91	2299	07	14	22
27.90	45	52	60	67	75	82	90	97	05	12	20
27.95	43	51	58	66	73	81	88	96	03	11	18

Table 1. For computing density, σ, of sea water for various values of salinity, S, and of temperature, t--Concluded

Temperature, t	Salinity, S, in ‰										
	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0
°											
28.00	2242	2249	2257	2264	2272	2279	2287	2294	2302	2309	2317
28.05	40	47	55	62	70	77	85	93	00	08	15
28.10	38	46	53	61	68	76	83	91	2298	06	13
28.15	37	44	52	59	67	74	82	89	97	04	12
28.20	35	42	50	57	65	73	80	88	95	03	10
28.25	33	41	48	56	63	71	78	86	93	01	08
28.30	32	39	47	54	62	69	77	84	92	2299	07
28.35	30	38	45	53	60	68	75	83	90	98	05
28.40	28	36	43	51	58	66	73	81	88	96	03
28.45	27	34	42	49	57	64	72	79	87	94	02
28.50	2225	2233	2240	2248	2255	2263	2270	2278	2285	2293	2300
28.55	23	31	38	46	53	61	68	76	83	91	2298
28.60	22	29	37	44	52	59	67	74	82	89	97
28.65	20	28	35	43	50	58	65	73	80	88	95
28.70	18	26	33	41	48	56	63	71	78	86	93
28.75	17	24	32	39	47	54	62	69	77	84	92
28.80	15	23	30	38	45	53	60	68	75	83	90
28.85	13	21	28	36	43	51	58	66	73	81	88
28.90	12	19	27	34	42	49	57	64	72	79	87
28.95	10	18	25	33	40	48	55	63	70	78	85
29.00	2208	2216	2223	2231	2238	2246	2253	2261	2269	2276	2284
29.05	07	14	22	29	37	44	52	59	67	74	82
29.10	05	13	20	28	35	43	50	58	65	73	80
29.15	03	11	18	26	33	41	48	56	63	71	78
29.20	02	09	17	24	32	39	47	54	62	69	77
29.25	00	08	15	23	30	38	45	53	60	68	75
29.30	2198	06	13	21	28	36	43	51	58	66	73
29.35	97	04	12	19	27	34	42	49	57	64	72
29.40	95	02	10	17	25	32	40	47	55	62	70
29.45	93	01	08	16	23	31	38	46	53	61	68
29.50	2192	2199	2207	2214	2222	2229	2237	2244	2252	2259	2267
29.55	90	97	05	12	20	27	35	42	50	57	65
29.60	88	96	03	11	18	26	33	41	48	56	63
29.65	86	94	01	09	16	24	31	39	46	54	61
29.70	85	92	2200	07	15	22	30	37	45	52	60
29.75	83	91	2198	06	13	21	28	36	43	51	58
29.80	81	89	96	04	11	19	26	34	41	49	56
29.85	80	87	95	02	10	17	25	32	40	47	55
29.90	78	86	93	00	08	15	23	30	38	45	53
29.95	76	84	91	2199	06	14	21	29	36	44	51
30.00	2175	2182	2190	2197	2205	2212	2220	2227	2235	2242	2250

Table 2. Corrections for depth and temperature and for depth and salinity to obtain density of sea water

(Tabular values are in units of fifth decimal)

Depth dy- namic meters	Temperature, t, in degrees centigrade												
	-2	-1	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	2	2	2	2	2	2	2	2	2	2	2	2	2
25	12	12	12	12	12	12	12	12	12	12	12	12	12
50	25	25	25	25	25	25	25	25	24	24	24	24	24
75	38	38	37	36	36	36	36	36	35	35	35	35	35
100	50	49	49	49	48	48	48	48	47	47	47	47	47
150	75	74	74	73	73	73	72	72	71	71	71	71	70
200	99	99	98	97	97	96	96	95	95	94	94	94	93
250	124	124	123	122	121	121	120	120	119	118	118	117	117
300	149	148	147	146	145	144	144	143	142	142	141	140	140
400	198	197	196	195	194	193	192	191	190	189	188	187	187
500	248	246	245	244	242	241	240	238	237	236	235	234	233
700	346	344	342	340	338	336	334	333	331	330	328	327	326
1000	493	490	487	484	482	479	476	474	472	470	468	466	464
1500	736	732	728	724	719	716	712	709	705	702	699	696	694
2000	977	971	965	960	954	949	945	940	936	931	927	924	920
2500	1214	1207	1200	1193	1187	1181	1175	1169	1164	1159	1154	1149	1145
3000	1451	1442	1434	1426	1419	1411	1404	1398	1391	1385	1379	1374	1369
3500	1684	1674	1665	1656	1647	1639	1631	1623	1616	1609	1602	1596	1590
4000	1915	1903	1893	1883	1873	1864	1855	1846	1838	1830	1823	1816	1809
4500	2144	2132	2120	2109	2098	2088	2078	2068	......	......	......	......	......
5000	2371	2358	2345	2333	2321	2309	2299	2288	......	......	......	......	......
5500	2596	2581	2567	2553	2541	......	......	......	......	......	......	......	......
6000	2819	2803	2788	2773	2760	......	......	......	......	......	......	......	......

				Salinity, S, in o/oo											Depth dy- namic meters
15	20	25	30	30	31	32	33	34	35	36	37	38	39	40	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	5
11	11	11	11	0	0	0	0	0	0	0	0	0	0	0	25
23	23	23	23	0	0	0	0	0	0	0	0	0	0	0	50
35	34	34	34	0	0	0	0	0	0	0	0	0	0	0	75
46	45	45	45	1	1	0	0	0	0	0	0	0	- 1	- 1	100
69	68	67	66	1	1	1	0	0	0	0	0	- 1	- 1	- 1	150
92	90	89	87	2	1	1	1	0	0	0	- 1	- 1	- 1	- 2	200
115	113	111	...	2	2	1	1	0	0	0	- 1	- 1	- 1	- 2	250
137	136	134	...	2	2	1	1	0	0	0	- 1	- 1	- 2	- 2	300
183	181	179	...	3	3	2	1	1	0	-1	- 1	- 2	- 3	- 3	400
229	226	.....	...	4	3	3	2	1	0	-1	- 2	- 3	- 3	- 4	500
320	316	.....	...	6	5	3	2	1	0	-1	- 2	- 3	- 5	- 6	700
456	.....	.....	...	8	7	5	3	2	0	-2	- 3	- 5	- 7	- 8	1000
682	.....	.....	...	12	10	8	4	2	0	-2	- 4	- 8	-10	-12	1500
905	.....	.....	...	16	13	10	6	3	0	-3	- 6	-10	-13	-16	2000
1126	.....	.....	...	20	16	12	8	4	0	-4	- 8	-12	-16	-20	2500
1347	.....	.....	...	23	19	14	9	5	0	-5	- 9	-14	-19	-23	3000
1565	.....	.....	...	27	22	16	11	5	0	-5	-11	-16	-22	-27	3500
1780	.....	.....	...	30	24	18	12	6	0	-6	-12	-18	-24	-30	4000
......	.....	.....	...	34	27	20	14	7	0	-7	-14	-20	-27	-34	4500
......	.....	.....	...	37	30	22	15	8	0	-8	-15	-22	-30	-37	5000
......	.....	.....	...	...	...	...	16	8	0	-8	-16	.....	.....	.....	5500
......	.....	.....	...	...	...	...	17	9	0	-9	-17	.....	.....	.....	6000

Table 3. Corrections for protected deep-sea reversing thermometer because of differences between observed reading T', and reading, t, of auxiliary attached thermometer; total correction Δt is sum of tabular value (negative for negative values of $T' - t$) and index correction I*

Obs'd. temp. diff. $(T' - t)$	$(T' + v_0)$ in degrees centigrade									
	91	92	93	94	95	96	97	98	99	100
1	0.015	0.015	0.015	0.016	0.016	0.016	0.016	0.016	0.016	0.017
2	0.030	0.031	0.031	0.031	0.032	0.032	0.032	0.033	0.033	0.033
3	0.045	0.046	0.046	0.047	0.047	0.048	0.048	0.049	0.049	0.050
4	0.061	0.061	0.062	0.063	0.063	0.064	0.065	0.065	0.066	0.067
5	0.076	0.077	0.077	0.078	0.079	0.080	0.081	0.082	0.082	0.083
6	0.091	0.092	0.093	0.094	0.095	0.096	0.097	0.098	0.099	0.100
7	0.106	0.107	0.108	0.110	0.111	0.112	0.113	0.114	0.115	0.117
8	0.121	0.122	0.124	0.125	0.127	0.128	0.129	0.131	0.132	0.133
9	0.136	0.138	0.139	0.141	0.142	0.144	0.145	0.147	0.148	0.150
10	0.151	0.153	0.155	0.156	0.158	0.160	0.162	0.163	0.165	0.167
11	0.167	0.168	0.170	0.172	0.174	0.176	0.178	0.180	0.181	0.183
12	0.182	0.184	0.186	0.188	0.190	0.192	0.194	0.196	0.198	0.200
13	0.197	0.199	0.201	0.203	0.206	0.208	0.210	0.212	0.214	0.217
14	0.212	0.214	0.217	0.219	0.221	0.224	0.226	0.229	0.231	0.233
15	0.227	0.230	0.232	0.235	0.237	0.240	0.242	0.245	0.247	0.250
16	0.242	0.245	0.247	0.250	0.253	0.256	0.258	0.261	0.264	0.267
17	0.257	0.260	0.263	0.266	0.269	0.272	0.275	0.277	0.280	0.283
18	0.273	0.276	0.279	0.282	0.285	0.288	0.291	0.294	0.297	0.300
19	0.288	0.291	0.294	0.297	0.301	0.304	0.307	0.310	0.315	0.317
20	0.303	0.306	0.310	0.313	0.316	0.320	0.323	0.326	0.330	0.333
21	0.318	0.321	0.325	0.329	0.332	0.336	0.339	0.343	0.346	0.350
22	0.333	0.337	0.340	0.344	0.348	0.352	0.355	0.359	0.363	0.367
23	0.348	0.352	0.356	0.360	0.364	0.368	0.372	0.375	0.379	0.383
24	0.363	0.367	0.371	0.376	0.380	0.384	0.388	0.392	0.396	0.400
25	0.379	0.383	0.387	0.391	0.395	0.400	0.404	0.408	0.412	0.417
26	0.394	0.398	0.402	0.407	0.411	0.416	0.420	0.424	0.429	0.433
27	0.409	0.413	0.418	0.422	0.427	0.432	0.436	0.441	0.445	0.450
28	0.424	0.429	0.433	0.438	0.443	0.448	0.452	0.457	0.462	0.467
29	0.439	0.444	0.449	0.454	0.459	0.464	0.468	0.473	0.478	0.483
30	0.454	0.459	0.464	0.459	0.474	0.480	0.485	0.490	0.495	0.500
31	0.469	0.475	0.480	0.485	0.490	0.496	0.501	0.506	0.511	0.517
32	0.485	0.490	0.495	0.501	0.506	0.512	0.517	0.522	0.528	0.533
33	0.500	0.505	0.511	0.516	0.522	0.528	0.533	0.539	0.544	0.550
34	0.515	0.521	0.526	0.532	0.538	0.543	0.549	0.555	0.561	0.567
35	0.530	0.536	0.542	0.548	0.554	0.559	0.565	0.571	0.577	0.583
36	0.545	0.551	0.557	0.563	0.569	0.575	0.582	0.588	0.594	0.600
37	0.560	0.566	0.573	0.579	0.585	0.591	0.598	0.604	0.610	0.616
38	0.575	0.582	0.588	0.595	0.601	0.607	0.614	0.620	0.627	0.633
39	0.590	0.597	0.604	0.610	0.617	0.623	0.630	0.637	0.643	0.650
40	0.606	0.612	0.619	0.626	0.633	0.639	0.646	0.653	0.660	0.666
41	0.621	0.628	0.635	0.641	0.648	0.655	0.662	0.669	0.676	0.683
42	0.636	0.643	0.650	0.657	0.664	0.671	0.678	0.686	0.693	0.700
43	0.651	0.658	0.666	0.673	0.680	0.687	0.695	0.702	0.709	0.716
44	0.666	0.674	0.681	0.688	0.696	0.703	0.711	0.718	0.726	0.733
45	0.681	0.689	0.696	0.704	0.712	0.719	0.727	0.735	0.742	0.750
46	0.696	0.704	0.712	0.720	0.728	0.735	0.743	0.751	0.759	0.766
47	0.712	0.720	0.727	0.735	0.743	0.751	0.759	0.767	0.775	0.783
48	0.727	0.735	0.743	0.751	0.759	0.767	0.775	0.784	0.792	0.800
49	0.742	0.750	0.758	0.767	0.775	0.783	0.792	0.800	0.808	0.816
50	0.757	0.765	0.774	0.782	0.791	0.799	0.808	0.816	0.825	0.833
51	0.772	0.781	0.789	0.798	0.807	0.815	0.824	0.832	0.841	0.850
52	0.787	0.796	0.805	0.814	0.822	0.831	0.840	0.849	0.858	0.866
53	0.802	0.811	0.820	0.829	0.838	0.847	0.856	0.865	0.874	0.883
54	0.818	0.827	0.836	0.845	0.854	0.863	0.872	0.881	0.891	0.900
55	0.833	0.842	0.851	0.861	0.870	0.879	0.888	0.898	0.907	0.916
56	0.848	0.857	0.867	0.876	0.886	0.895	0.905	0.914	0.924	0.933
57	0.863	0.873	0.882	0.892	0.902	0.911	0.921	0.930	0.940	0.950
58	0.878	0.888	0.898	0.907	0.917	0.927	0.937	0.947	0.957	0.966
59	0.893	0.903	0.913	0.923	0.933	0.943	0.953	0.963	0.973	0.983
60	0.908	0.919	0.929	0.939	0.949	0.959	0.969	0.979	0.990	1.000

* Strictly speaking, Δt = tabular value + I + $0.000164\,(T' + v_0)\,I$, but the term $0.00164\,(T' + v_0)\,I$ may be neglected for well-made thermometers for which I does not exceed $0\overset{\circ}{.}1$.

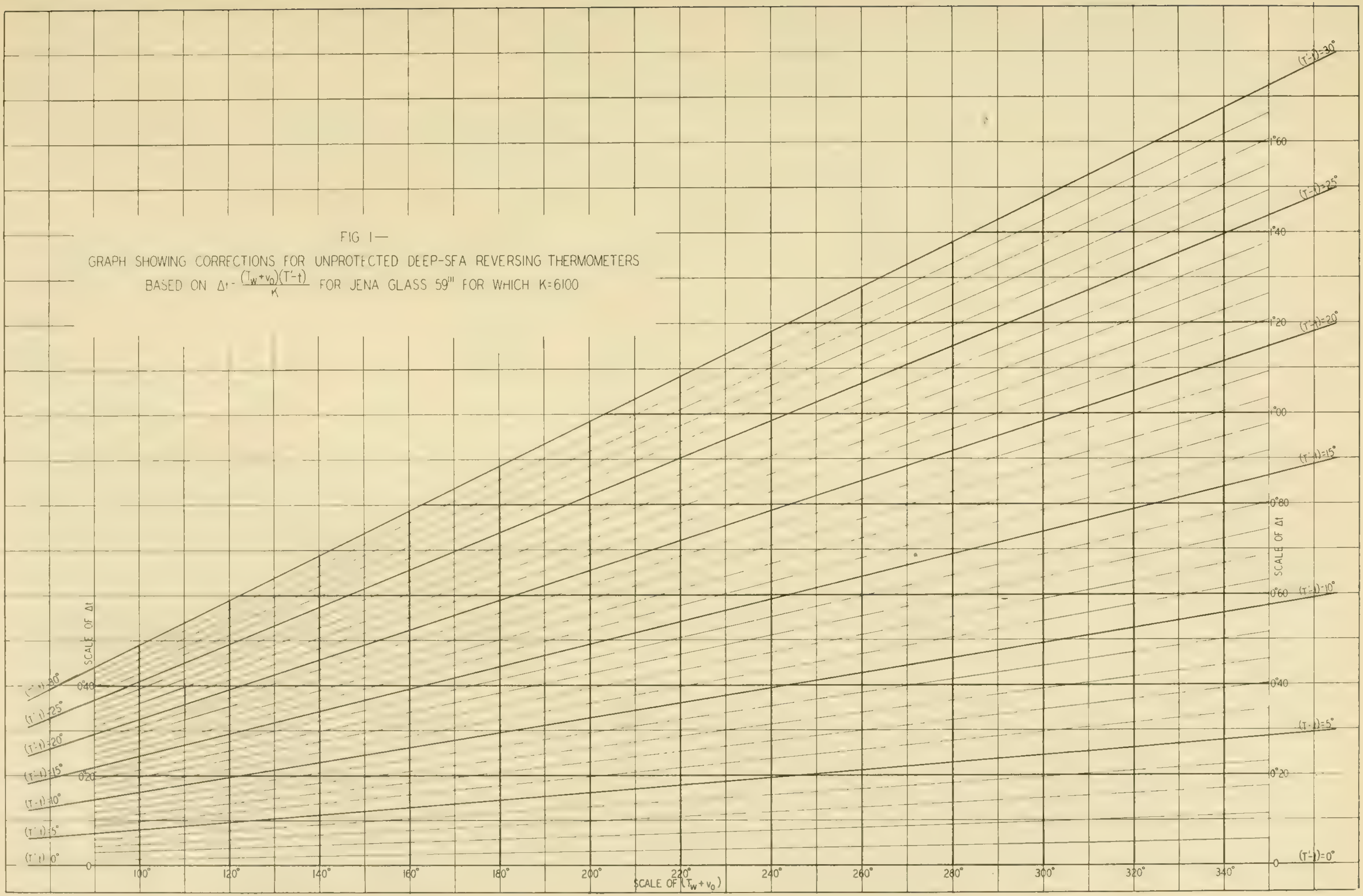


FIG 1—
GRAPH SHOWING CORRECTIONS FOR UNPROTECTED DEEP-SEA REVERSING THERMOMETERS
BASED ON $\Delta t = \frac{(T_w+v_0)(T'-t)}{K}$ FOR JENA GLASS 59''' FOR WHICH K=6100

At a number of stations from station 7 to station 49 wire depths were obtained by the 4-mm wire. In all cases a water bottle provided with an unprotected and a protected thermometer was attached to the end of the wire and the depth was computed from the indications of the thermometers. The accuracy of this method has been discussed previously. No independent determinations of depth by means of the 4-mm wire were made and it is, therefore, unnecessary to enter on a discussion of the relation between wire length, wire angle, and depth at these stations.

At the greater number of the stations from 40 to 162 the depth was determined by means of sounding with piano wire. The wire angle was in many instances very great and it is, therefore, necessary to examine the relation between wire length, wire angle, and depth in these cases. In a number of cases a reversing frame, carrying two thermometers, one unprotected and one protected, was attached to the end of the wire. This frame was released by a propeller and according to experiments it had to be hauled up a distance of 25 meters before it was reversed. From the indications of the two thermometers the depth at which the frame was reversed can be computed with an accuracy of about ±0.5 per cent. Adding to this depth the distance of the frame from the lead at the end of the wire and the distance of 25 meters which the frame had to be hauled up before reversal, the depth at the station is obtained with the same accuracy. Omitting the observations at eight stations at which the frame evidently had reversed at a wrong level, thirty-four stations remain from which corresponding values of depth, wire length and wire angle are available. The data from these stations have been compiled in table 1 in which the cosine of the wire angle and the ratio between the observed depth and the wire length also are entered, the latter under the headline "depth factor." It is seen that the depth factor is usually smaller than the cosine of the wire angle at the surface, which means that the wire angle decreased when approaching the bottom.

In figure 1 the depth factor has been plotted against the wire angle and the single values are grouped around a smooth curve. The scattering of the values is small, considering that the depth factor for any given wire angle depends on the curvature of the wire which again is controlled by the change of current with depth, and by the

Table 1. Comparison between wire length, wire angle, and thermometer depth at stations where sounding with piano wire was undertaken

Station no.	Wire length, meters	Wire angle, degrees	Cosine of wire angle	Thermometer depth, meters	Depth factor	Adopted depth factor	Wire depth, meters	Thermometer depth minus wire depth, meters
52	2873	18	0.951	2851	0.992	0.978	2810	41
64	3902	17	0.956	3879	0.994	0.979	3820	59
65	3698	25	0.906	3626	0.981	0.968	3580	46
67	1100	12	0.978	1089	0.990	0.986	1085	4
82	3937	47	0.682	3631	0.922	0.928	3654	-23
83	4100	25	0.906	3982	0.971	0.968	3969	13
84	4187	18	0.951	4121	0.984	0.978	4095	26
85	3814	5	0.996	3770	0.988	0.994	3791	-21
86	2175	19	0.946	2132	0.980	0.977	2125	7
110	3067	10	0.985	3036	0.990	0.988	3030	6
117	5410	22	0.927	5296	0.979	0.972	5259	37
127	4310	41	0.755	4018	0.932	0.940	4051	-33
127	4273	50	0.643	4034	0.944	0.921	3935	99
128	4105	51	0.629	3785	0.922	0.919	3772	13
128	4194	52	0.616	3826	0.912	0.916	3842	-16
131	4586	30	0.866	4418	0.963	0.960	4403	15
132	4456	35	0.819	4251	0.954	0.951	4238	13
133	4652	33	0.839	4426	0.951	0.954	4438	-12
134	4676	12	0.978	4528	0.968	0.986	4611	-83
135	4882	10	0.985	4695	0.962	0.988	4823	-128
137	5506	45	0.707	5208	0.946	0.932	5132	75
138	6057	65	0.423	5382	0.889	0.884	5354	28
139	5429	35	0.819	5030	0.927	0.951	5163	-133
140	5222	55	0.574	4762	0.912	0.910	4752	10
141	6018	45	0.707	5667	0.942	0.932	5609	58
142	6051	32	0.848	5787	0.956	0.956	5787	0
146	5328	58	0.530	4756	0.893	0.902	4806	-50
149	5556	35	0.819	5320	0.958	0.951	5284	36
150	4687	20	0.940	4553	0.971	0.975	4570	-17
151	5094	20	0.940	4918	0.965	0.975	4967	-49
159	5721	25	0.906	5545	0.969	0.968	5538	7
160	2728	25	0.906	2614	0.958	0.968	2641	-27
161	4584	13	0.974	4484	0.978	0.985	4515	-31
162	5221	0	1.000	5124	0.981	1.000	5221	-97

weight at the end of the wire, which was not kept constant, and by the speed of lowering. The depth factor corresponding to any given wire angle can be read off from the curve in figure 1 and the wire depth obtained by multiplying the wire length with this factor.

In order to estimate the probable errors of the wire depths which have been determined by this method, such wire depths have been computed in the cases in which the depth was determined independently by thermometer and entered in table 1 together with the differences between the wire depths and the thermometer depths. These differences, which are represented graphically in figure 2, increase with increasing depth, which means that the error in the wire depth increases with depth. All points except three fall inside the two straight lines which have been drawn in the figure, representing a difference of 2.5 per cent of the depth. Of this difference 0.5 per cent can be regarded as owing to uncertainty in the thermometer depth and the maximum error of the wire depth is thus about 2 per cent of the depth. It is evident from the graph and from the values in the table that the error of the wire depth as a rule is considerably smaller, especially if the depth is small. The result must be regarded as very satisfactory, considering that wire angles greater than 40° frequently occurred.

Summarizing the preceding discussion it can be stated that when sounding with piano wire has been undertaken and the wire length and wire angle recorded, the wire depth can be found by multiplying the wire length by a factor which is read off from figure 1. The wire depth which has been computed by this method has a maximum error of 2 per cent.

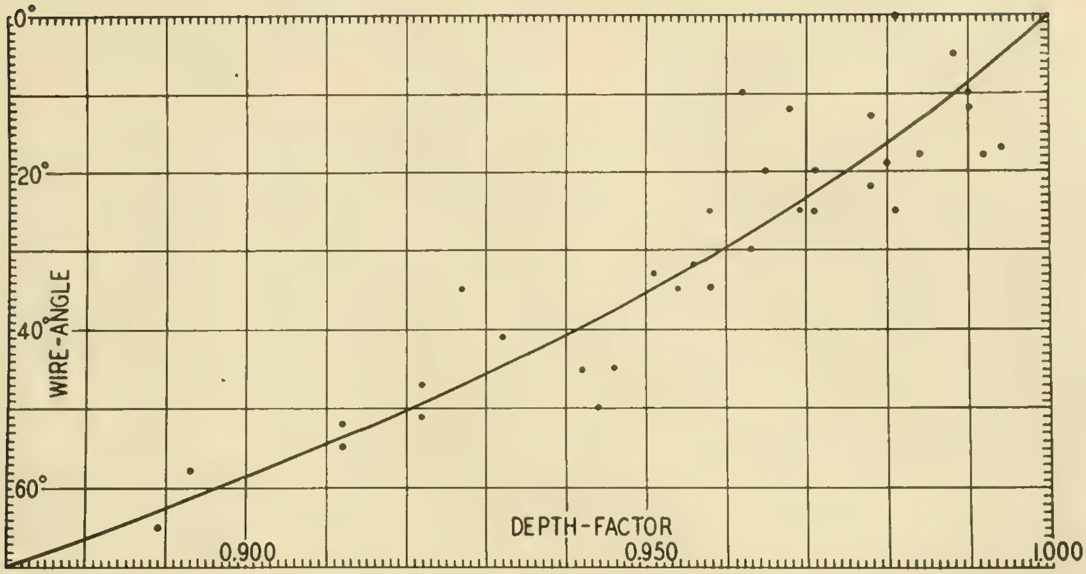


FIG. 1 - RELATION BETWEEN WIRE ANGLE AND FACTOR BY WHICH WIRE LENGTH MUST BE MULTIPLIED TO OBTAIN DEPTH WHEN SOUNDING WITH PIANO WIRE

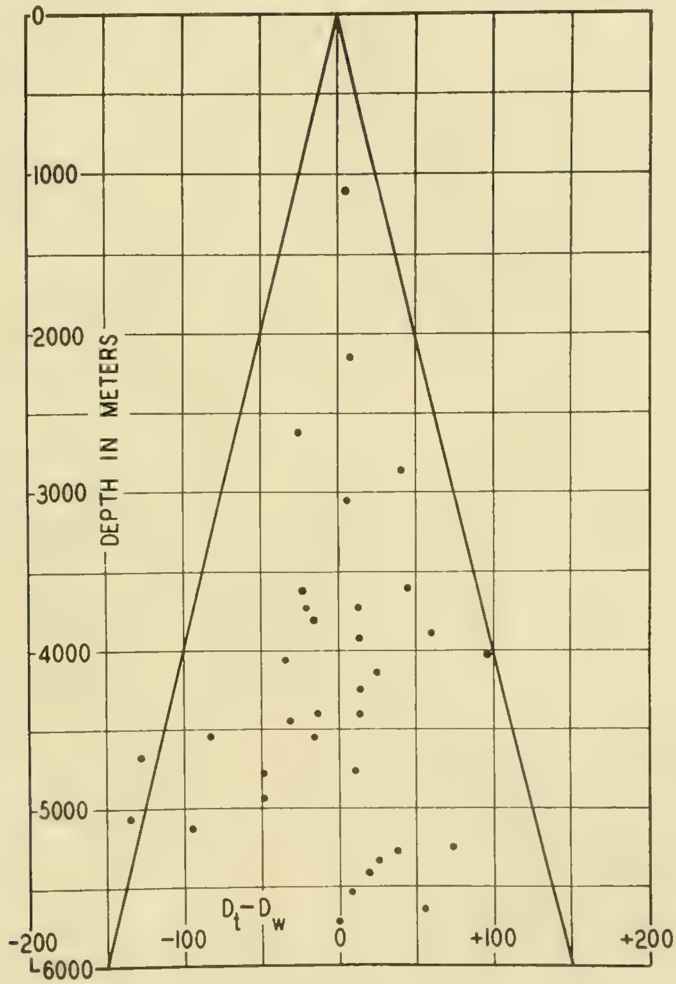


FIG. 2 - THERMOMETER DEPTH (D_t) MINUS WIRE DEPTH (D_w) AS A FUNCTION OF DEPTH

During the summer of 1927 while the Carnegie was being overhauled prior to the beginning of her seventh cruise, sonic depth-finding equipment loaned by the United States Navy Department was installed. This equipment was of a type well suited for deep-sea sounding and consequently fitted the needs of the Carnegie. A Fessenden type of oscillator having a 30-inch steel diaphragm was located in the keel below the after part of the engine room. This oscillator, which was the source of sound of 540-cycle frequency, was actuated electromagnetically, being supplied with alternating current of 540-cycle frequency at 180 volts and direct current at 115 volts. A 5-kilowatt remote-controlled motor generator set for the alternating-current supply was located in the toolroom just off the engine room on the port side; the control panel was located in the engine room near the forward end. Six Navy hydrophones, any three of which could be used at one time, were located along the port garboard strake below the chartroom.

The depth finder proper was located in the control room (a deckhouse on the port side of the forward end of the quarter-deck). The depth finder acted as the clock for measuring the time required for the sound to travel from the surface to the bottom and return. It consisted of a tuning fork-controlled rotary converter which drove a large bakelite disc at constant speed. Riding on, and driven by this bakelite disc, was a smaller accurately machined brass disc mounted on a splined shaft carrying a series of commutators which made and broke the electrical circuit of a relay; this, in turn, operated the oscillator, thus sending out signals at periodic intervals. By means of a calibrated screw the radius at which the brass disc rode on the bakelite disc, and consequently the time interval between signals, was continuously variable between limits set by the dimensions of the bakelite disc. The outgoing signals and the returned echoes were audible in the telephone receivers, and in taking a sounding the position of the brass disc on the bakelite disc was adjusted until the outgoing signals occurred simultaneously with the returned echoes of the immediately preceding signals. Under this condition, the time required for a signal to travel to bottom and return was the same as the time interval between two successive signals. A dial operated by the calibrated screw indicated, in effect, the latter time interval.

A table, based on an arbitrarily selected sound velocity of 1450 meters per second, was made for converting dial readings into approximate depths, due consideration being given the horizontal distance between oscillator and hydrophones. As the velocity of sound in sea water is a variable depending chiefly on temperature, salinity, and pressure, the approximate depth was then multiplied by the suitable correction factor selected from a table applicable to the area in which the sounding was taken. To the value thus obtained, a further correction for draft was applied.

As originally installed, the outgoing signal was brought to the receivers from the secondary of an air-core transformer, the primary of which was in the alternating-current circuit of the oscillator. Thus there would be heard, first the electrically conducted impulse of the outgoing signal, then the outgoing signal as a direct sound wave picked up by the hydrophones, and finally the reflected sound wave as picked up by the hydrophones. As the first two arrived but a short time apart, it resulted in a blurred sound of considerable intensity, which had to be matched in time of arrival with a fainter sound of shorter duration. Later on the arrangement was changed and the air-core transformer eliminated, so that the outgoing signal was registered only as the direct sound wave picked up by the hydrophones. This resulted in a sharper outgoing signal in the receivers, and a consequently greater ease and accuracy in getting a balance. After this change in arrangement, a further constant correction of half the distance between oscillator and hydrophones was added.

The correction factors applicable to a certain locality were grouped into a table of ratios of the average velocity of sound down to the applicable depth, to the basic velocity of 1450 meters per second. These were based on the British Admiralty Hydrographic Department Publication No. 282 entitled "Tables of the velocity of sound in pure water and sea-water for use in echo-sounding and sound-ranging." The variation in pressure at a given depth, due to the variation in gravity with latitude, was considered to be small enough to be disregarded. The range in temperature normally encountered is from -2° to +30° C, whereas the salinity range is within 31.00 to 38.00 parts per thousand. Correction factors were computed for salinities of 31.00 and 38.00 parts per thousand and all even degrees of temperature from -2° to +30° C, using tables 2 and 3 of the British Admiralty publication cited above. From these factors a set of straight-line curves was drawn, one curve for each degree. Although the isothermal variation of velocity with salinity is not linear, it was sufficiently so for this purpose.

Curves based on the data in table 1 give the correction factor to the basic velocity at any salinity and temperature at atmospheric pressure. The amounts to be added to the values derived from table 1 because of pressure effect, as taken from table 4 of the British Admiralty publication, are shown in table 2.

A set of correction factors was prepared every two days from actually measured temperatures and salinities in the following manner. Vertical distribution curves of temperature and salinity were plotted, and from these curves were scaled the values at the nominal depths (in meters) of 0, 25, 50, 75, 100, 200, 300, 400, 500, 1000, 1500, 2000, etc. The temperature and salinity measurements usually extended to depths of from 2000 to 4000 meters. The vertical distribution curves were extrapolated to depths ordinarily about 500 meters greater than the deepest soundings obtained in the area in question. The extrapolations were made with the help of composite curves based on measurements made in areas where the deep water was homogeneous. These group extrapolations are discussed in the section on sounding velocity. From the velocity correction curves, values of corrections were obtained for the conditions of temperature and salinity prevailing at the nominal depths. To these were added the corrections, due to pressure, corresponding to the appropriate depth and temperature, and taken from table 2. The sum of these two corrections was entered in a column headed "velocity corrections" opposite the proper depth. The procedure for getting the

Table 1. Data used for graphs to determine correction factors to basic velocity at any salinity and temperature at atmospheric pressure

Temperature, °C	Salinity 31.00 per mille		Salinity 38.00 per mille	
	Velocity, m/sec	$\left[\frac{\text{Velocity}}{1450}\right]-1$	Velocity, m/sec	$\left[\frac{\text{Velocity}}{1450}\right]-1$
-2	1430.96	-.0131	1440.04	-.0069
-1	1435.68	-.0099	1444.72	-.0036
0	1440.30	-.0067	1449.30	-.0005
1	1444.92	-.0035	1453.88	+.0027
2	1449.34	-.0005	1458.26	+.0057
3	1453.76	+.0026	1462.64	+.0087
4	1458.08	+.0056	1466.92	+ 0117
5	1462.20	+.0084	1471.00	+.0145
6	1466.34	+.0113	1475.08	+.0173
7	1470.38	+.0141	1479.06	+.0200
8	1474.32	+.0168	1482.94	+.0227
9	1478.16	+.0194	1486.72	+.0253
10	1481.90	+.0220	1490.40	+.0279
11	1485.56	+.0245	1493.94	+.0303
12	1489.12	+.0270	1497.38	+.0327
13	1492.68	+.0294	1500.82	+.0350
14	1496.04	+.0317	1504.06	+.0373
15	1499.30	+.0340	1507.20	+.0394
16	1502.52	+.0362	1510.38	+.0416
17	1505.54	+.0383	1513.36	+.0437
18	1508.56	+.0404	1516.34	+.0458
19	1511.48	+.0424	1519.22	+.0477
20	1514.30	+.0443	1522.00	+.0497
21	1517.04	+.0462	1524.68	+.0515
22	1519.78	+.0481	1527.36	+.0534
23	1522.42	+.0499	1529.94	+.0551
24	1524.96	+.0517	1532.42	+.0568
25	1527.50	+.0534	1534.90	+.0585
26	1529.92	+.0551	1537.28	+.0602
27	1532.24	+.0567	1539.56	+.0618
28	1534.56	+.0583	1541.84	+.0633
29	1536.88	+.0599	1544.12	+.0649
30	1539.00	+.0614	1546.20	+.0663

correction factors applicable to the various depths was from this point on a more or less obvious one of taking means. A specimen set of computations of correction factors is reproduced in table 3.

Criticism may be made of the arbitrary selection of the basic velocity of 1450 meters per second for the compilation of calibration tables. Consideration was given to the selection of some velocity which would have some significance other than merely being the base for a set of tables. For instance, such as the velocity of sound in water of 35.00 per mille salinity, 0° C temperature, and atmospheric pressure. So far as could be learned, however, practice had not crystallized to the point of selecting such a velocity which could be considered as standard, and as any velocity might be used equally as well as any other velocity, it was considered best for the purpose to select a figure which was approximately a round number, was somewhere near the true velocity, and would give corrections which would be additive in nearly all cases. It was for these reasons that 1450 meters per second was the velocity selected.

An estimate of the accuracy of each sounding was made and recorded at the time of the measurement. The method of arriving at these estimates may be of interest. The rotary converter and its controlling tuning fork were of 60-cycle frequency. As long as synchronism was maintained, the two had to maintain a phase relation which was constant within a quarter-cycle, and it is probable that the successful synchronizing range was about one-eighth of a cycle. This meant that relative to the tuning fork, the rotating parts were varying in phase by a maximum of 1/480 second or about 3 meters in distance. As the distance traveled was twice the depth, the uncertainty in depth due to this cause was about 1.5 meters. As there was no temperature control or compensation on the tuning fork, and as there was about 10° C range on either side of the mean, and as the tuning-fork rate had a temperature coefficient of about 0.007 per cent per degree centigrade, it was considered that the time intervals indicated were subject to an error of 0.1 per cent. Further, there was an uncertainty of the dial setting within which the outgoing and returning signals sounded as one to the operator. This uncertainty was converted into depth and if greater than 0.1 per cent and greater than 1.5 meters, it was recorded as the uncertainty of the measurement. If it was less than 0.1 per cent but greater than 1.5 meters, 0.1 per cent of the sounding was recorded as the uncertainty. And if the distance 1.5 meters was greater than both the uncertainty of setting and 0.1 per cent, then it was recorded as the uncertainty of measurement. It was thought that this was a reasonable procedure of estimating the accuracy of soundings. This is assuming, however, that the frequency of the tuning fork was accurately adjusted to 60 cycles per second, that the sounding velocity used was accurate, that the sounding distance was vertical, and that no gross errors were involved. The conditions of temperature and salinity at nearby oceanographic stations are on record, and if in the future it is found that the velocities used were inaccurate, corrections may be made. Very often echoes would be reflected from more than one surface. In such cases the first echo to return was selected as being from that surface which was most nearly vertically beneath the ship. Because of the comparatively gentle slopes of the ocean bottom, such a procedure is probably not greatly in error in soundings at sea, although it is recognized that in steep gradients, such as are encountered in certain approaches to land, the error may be considerable. Gross errors are possible when the returned echoes are matched with second or third succeeding signals instead of with the immediately succeeding signal, thus giving one-half, or one-third, the actual depth. Such errors are easily avoidable by sending single signals in order to determine the order of magnitude of the depth. As the single signal was usually used to determine the number of reflecting surfaces and the number of echoes, there was little possibility of gross errors entering the Carnegie results from this cause. Actually, the frequency of the tuning fork was not accurately adjusted to 60 cycles per second and corrections, which will be dealt with below, have been applied to the soundings taken with the sonic depth finder.

A program of sounding every four hours was attempted. During such times as the ship was becalmed or making little headway, soundings were taken about every ten miles. This program was, in general, followed but in areas of rapidly changing depth more frequent soundings were made. Other deviations from this schedule sometimes occurred to avoid interference with pilot-balloon ascensions, or radio schedules, and occasionally because of the press of other work. Short interruptions to the sounding program were sometimes caused by the necessity of making repairs to the depth finder or to the gasoline engine which drove the main generator. The

Table 2. Amounts to be added to correction factor because of pressure effect

Depth in meters	Temperature, °C		Amount	Depth in meters	Temperature, °C		Amount
	From	To			From	To	
25	-2	+25	.0003	500	-2	+5	.0063
50	-2	+25	.0006	1000	-2	+5	.0126
75	-2	+25	.0009	1500	-2	+5	.0188
100	-2	+25	.0012	2000	-2	+5	.0250
200	-2	+25	.0025	2500	-2	+3	.0313
300	-2	+25	.0037	3000	-2	+3	.0375
400	-2	+25	.0050	3500	-2	+3	.0437

Depth in meters	Temperature, °C				
	-1	0	+1	+2	+3
4000	.0499	.0499	.0499	.0499	.0498
4500	.0561	.0561	.0560	.0559	.0559
5000	.0623	.0621	.0621	.0621	.0619
5500	.0684	.0683	.0683	.0681	.0680
6000	.0745	.0744	.0743	.0742	.0741
6500	.0806	.0805	.0803	.0801	.0800
7000	.0866	.0865	.0863	.0861	.0859
7500	.0926	.0925	.0923	.0920	.0918
8000	.0986	.0984	.0981	.0979	.0977
8500	.1046	.1043	.1040	.1037	.1034
9000	.1104	.1101	.1099	.1095	.1092
9500	.1162	.1159	.1156	.1153	.1150

Table 3. Specimen determination of correction factors

Station 93; latitude 14° 41!3 south, longitude 167° 40!8 west; Sunday, March 31, 1929; Comp. F.M.S.

D	T_K	S	Vel. corr.	Mean corr. of layer			Sum of means	Corr. fact.
				25	100	500		
m	°	o/oo						
0	28.74	34.71	.0622		....	....	1.0624	1.0622
5	28.75	34.68	....	.0624		....	2.1248	....
25	28.75	34.76	.0625	.0624	.0624	....	3.1872	1.0624
50	28.50	34.78	.0624	.0624			4.2495	1.0624
75	28.05	35.40	.0624	.0623			2.1212[a]	1.0624
100	27.55	35.85	.0622		.0588	.0485	3.1715[a]	1.0624
200	22.65	36.04	.0555		.0503		4.2112[a]	1.0606
300	16.90	35.28	.0451		.0397		5.2425[a]	1.0572
400	11.70	34.75	.0343		.0313		....	1.0528
500	8.90	34.57	.0283			....	1.0485	1.0485
700	5.65	34.38	....			.0246	2.0731	....
1000	3.95	34.47	.0210			.0222	3.0953	1.0366
1500	2.70	34.52	.0235			.0258	4.1211	1.0318
2000	2.15	34.57	.0282			.0310	5.1521	1.0303
2500	1.90	34.63	.0337			.0366	6.1887	1.0304
3000	1.70	34.66	.0394			.0424	7.2311	1.0314
3500	1.60	34.67	.0453			.0481	8.2792	1.0330
4000	1.40	34.67	.0509			.0535	9.3327	1.0349
4500	1.10	34.67	.0561			.0592	10.3919	1.0370
5000	1.10	34.67	.0622			.0653	11.4572	1.0392
5500	1.10	34.67	.0684			.0714	12.5286	1.0416
6000	1.10	34.67	.0744					1.0440
6500								
7000								
7500								
8000								

[a]These values and all values below heavy line by extrapolation.

longest and most serious interruption was caused by the failure of the oscillator on November 3, 1928. It was not until Callao was reached that repairs to the oscillator could be made, since such repairs required drydocking. Consequently, no accurate soundings were made between November 3, 1928 and February 6, 1929. Beginning November 14, 1928 rough soundings were made with an improvised shotgun. A steel breech just long enough to hold a 16-gage shotgun shell was screwed into one end of a length of brass pipe. The pipe acted as a holder and also as a guide for a heavy steel firing pin which was dropped into the upper and open end of the pipe, the shell end being held a foot or two below the surface. The hydrophones were used to pick up the echo and a stop wtach used to measure the elapsed time. Soundings were taken in this manner twice a day. These were only approximate because of the inaccuracy of the stop-watch measurement and because of the uncertainty of the velocity of a sound set up by an explosion. It was a case of half a loaf being better than none, however, and the device materially assisted in the routine occupation of oceanographic stations.

CORRECTIONS OF SONIC DEPTHS DETERMINED ON BOARD THE CARNEGIE ON ACCOUNT OF ERRORS IN THE TIMING

Depth was measured on board the Carnegie by three different methods, namely, by thermometers which were reversed at a short distance from the bottom, by wire soundings, and by sonic methods. The accuracy of soundings by thermometers or wire has been discussed and it has been shown that the depth obtained by thermometers can be regarded as reliable within ± 0.5 per cent; the depths by wire soundings are reliable within ± 2.0 per cent.

The accuracy of the depths determined by the sonic depth finder would be considerably greater than that of the other methods, supposing that no instrumental errors were present. Whether or not such errors occurred can be decided by examining the cases in which the depth was determined by thermometers or wire sounding close to a locality where the depth was measured by the sonic method. When making such an examination one must expect considerable variation in the results obtained by the different methods. This is partly because of the limited accuracy of the wire soundings, and partly because the sonic depth was not determined simultaneously with the other determination, for which reason irregularities of the bottom may give rise to discrepancies. The mean values obtained by the different methods, however, ought to agree if no systematic errors occur in the sonic depths.

When comparing the results by the different methods, it is to be noted that the timing of the sonic depth finder was readjusted February 19, 1929, and the comparison, therefore, must be made separately for the periods before and after this date. Table 1 gives the approximately simultaneous values of sonic depths and depths determined either by thermometers or by wire. The latter two are entered under the heading "true depth." The depths by thermometers have been entered, if available, because of the greater accuracy. The sonic depths entered in the table are derived from those sonic soundings which were made at the shortest distances from the locations at which the depths were determined by other methods. The last two columns of the table give the ratios between the true depths and the sonic depths, that is, the factor by which the sonic depth must be multiplied to obtain the true depth. The factors are arranged according to the character of the bottom. The bottom was regarded as being fairly regular when the difference between the two nearest sonic depths was less than 100 meters and the resulting factors are entered in the first of the last two columns. The bottom was regarded as irregular when the difference between the two nearest sonic depths exceeded 100 meters, and the resulting factors are entered in the last column.

It is seen that the sonic depths usually are greater than the depths by thermometers or wire. The bottom was extremely irregular or the wire depth was uncertain in a few outstanding cases, as is evident from the footnotes to the table. Omitting the nine cases indicated by these footnotes, fifty-nine approximately simultaneous values of sonic depths and thermometer or wire depths remain for comparison, twelve of which were obtained before, and forty-seven after, the readjustment of the timing February 19, 1929. The further discussion will be based on these fifty-nine cases only.

During the first period, using all twelve values, the mean sonic depth is 2871 meters, the mean true depth is 2683 meters, and the timing factor is 0.935. Using only the eight cases in which the depth was determined by means of thermometers, the mean sonic depth is 2327 meters, the mean true depth is 2197 meters, and the timing factor is 0.944.

The available data are much greater for the second period and a more detailed comparison between the sonic depths and the depths obtained by other methods can be made. The data of table 1 have been summarized in table 2, which gives the ratios between true depth and sonic depth for a number of different groups. The mean ratios were derived both from the mean depths and by forming the means of the single ratios. In the latter case the probable error of the mean value has been indicated.

From table 2 it is evident that the mean value of the ratio is practically independent of the grouping and also that the mean ratio, which is computed from the single ratios, agrees with the ratio of the mean depths. The latter feature shows that the ratio is nearly independent of depth. The mean errors in the last column show that the scattering of the single values of the ratio is smaller when the bottom is regular than when it is irregular, and also that the scattering is smaller when the true depth was determined by thermometers instead of by wire. Both these features should be expected. The irregular variations of the bottom and the greater error of the wire depths give rise to greater discrepancies.

From the preceding discussion it appears that the depths which were determined by means of the sonic depth finder during the period from February 19 to November 18, 1929 must be multiplied with a constant factor in order to give the true depth and the same evidently applies to the first period from May 13, 1928 to February 19, 1929. Considering that the most consistent results were obtained by comparison with depths which were determined by thermometers when the bottom was fairly regular, the following correction factors have been adopted for the soundings taken with the sonic depth finder: (1) May 13, 1928 to February 19, 1929, correction factor 0.944 and (2) February 19 to November 18, 1929, correction factor 0.964. The probable error of the latter factor is not greater than ± 0.003, but the probable error of the former is perhaps ± 0.009.

The instrumental error which makes application of these corrections to the sonic depths necessary must arise from an error of timing of the system. An error in the timing would lead to error in the sonic depth, which would be approximately proportional to the depth and therefore could be approximately eliminated by multiplication of the computed sonic depth with a constant factor. The fact that the correction factor was evidently changed when the timing was readjusted also indicates that the discrepancies arise from errors in timing. An error in timing should strictly be eliminated by correcting the time of echo before computing the sonic depth, but it can be shown that only an insignificant error is introduced by computing the sonic depth on the basis of the observed time of echo and correcting this computed depth by multiplication by a constant factor.

Table 1. Comparison of sonic depths with true depths as determined on the Carnegie, 1928-1929

Station no.	Sonic sounding no.	Sonic depth	True depth: Thermometer ±0.5 per cent	True depth: Wire ±2 per cent	Ratio (true/sonic): Bottom regular	Ratio (true/sonic): Bottom irregular
		m	m	m		
7	64	495	454	......	0.917	......
9	99	919	882	......	......	0.960
10	114	3210	3031	......	......	0.944
12	150	2849	2792	......	......	0.980
13	158	145	126	......	......	0.869
27	262	2831	......	2571	......	0.908
30	296	4988	4703	......	0.943	......
37	354	3500	3324	......	......	0.950
38	360	2512	2264	......	......	0.901
72	485	4819	......	4480	......	0.930
74	496	4565	......	4141[a]	0.907[a]	......
75	506	3912	......	3480	......	0.890
76	517	3387	......	2778[b]	......	0.820[b]
77	529	4275	......	4094	......	0.958
78[c]	536	3601	......	3337	0.927	......
79	547	3177	......	3064	......	0.964
79	547	3177	......	3116	......	0.981
80	559	3601	......	3515	0.976	......
81	572	3298	......	2953	......	0.895
82	585	3700	3631	......	......	0.981
83	596	4158	......	3966	0.954	......
84	609	4266	4121	......	0.966	......
85	622	3906	......	3791	0.971	......
86	658	2100	2132[d]	......	......	1.015[d]
87	672	4432	......	4315	0.974	......
94	759	4917	......	4760	0.968	......
96	779	5524	......	5269	0.954	......
97	789	5523	......	5253	......	0.951
108	921	4488	......	3573[e]	......	0.796[e]
109	932	5174	......	5252	1.015[f]	......
110	943	3172	3036	......	......	0.957
111	956	6106	......	6008	0.985	......
112	960	4445	3931[a]	......	......	0.884[a]
115	980	5636	......	5396	......	0.957
116	989	5902	......	5545	0.940	......
117	997	5525	5296	......	0.959	......
119	1015	5376	......	5198	......	0.967
127	1094	4296	4034	......	0.939	......
127	1094	4296	4018	......	0.935	......
128	1108	4118	3785	......	......	0.919
128	1108	4118	3826	......	......	0.929
131	1136	4597	4418	......	0.961	......
132	1151	4460	4251	......	0.953	......
133	1162	4545	4426	......	......	0.974
134	1172	4676	4528	......	......	0.968
135	1179	4829	4695	......	0.972	......
136	1187	4798	......	4713	0.982	......
137	1195	5339	5208	......	0.975	......
138	1206	5659	5382	......	......	0.951
139	1218	5262	5030	......	......	0.956
140	1227	4964	4762	......	......	0.959
141	1239	5847	5667	......	0.969	......
142	1249	5916	5787	......	......	0.978
145	1280	5728	......	5584	0.975	......
146	1289	5097	4756	......	......	0.933
147	1300	4893	......	4840	......	0.989
148	1310	4993	......	4835	......	0.968
149	1321	5377	5320	......	0.989	......
150	1332	4284	4553[d]	......	......	1.063[d]
151	1344	5062	4918	......	......	0.972
153	1365	5226	......	5003	0.957	......
155	1385	5173	......	5304	1.025[g]	......
156	1396	5247	......	4953	......	0.944
157	1415	4134	......	4693[d]	......	1.135[d]
159	1453	5607	5545	......	......	0.989
160	1470	2699	2614	......	0.969	......
161	1481	2624	4484	......	0.970	......
162	1490	5248	4124	......	......	0.976

[a] Original record indicates wire length somewhat uncertain. [b] Station probably on peak, sonic depths being much greater on either side. [c] Timing sonic depth finder readjusted between stations 77 and 78. [d] Station probably on slope, sonic depths being much greater on either side. [e] Sonic depths show irregular bottom but not such that so large a discrepancy should be expected. [f] On the slope of Fleming Deep. [g] Wire depth uncertain on account of heavy current and resulting large wire angle.

The velocity of sound, determined from experiments in which the source of sound is an explosion, is greater than when the source used is a diaphragm vibrating with constant amplitude. Further, the difference in velocities is dependent on the distance involved and the violence of the explosion. This has been explained as being the result of a sound wave train of normal velocity superimposed on an explosive wave which suffers great attenuation. On this assumption the greater initial velocity is a transient phenomenon, after the disappearance of which the velocity becomes normal.

Following this line of reasoning, one should expect to find that the soundings taken on the Carnegie with the improvised shotgun would have to be corrected for this effect. On thirty-four occasions the time of echo was measured for more than the first echo. These times of echo were accordingly investigated and are given in table 3. In one case the time was measured from the explosion to the return of the fourth and fifth echoes, and in thirty-three cases times were measured for first and second echoes. Of the thirty-three cases there were two in which the time was recorded as being doubtful, and in another case an error of one second was apparently made in reading the stop watch for the time of the second echo. In the remaining thirty cases the time for the first echo was subtracted from the time for the first two echoes to obtain the time for the second echo. The differences between the times for the first and second echoes were then taken. In the case where the times for four and five echoes were measured, it was assumed that the times for the second and succeeding echoes were the same. From this, the time for the first echo was computed and compared with the time for the fifth echo. In these thirty-one cases the average difference between the times for the first and succeeding echoes was 0.113 seconds.

The echo times have, therefore, been corrected on the assumption that the times of all first echoes, as measured, were too small by this amount. This was done by adding 85 meters to the gross depths based on first echoes alone, 64 meters to the gross depths based on first and second echoes, and 42 meters to the gross depths based on second echoes alone. The shotgun soundings adjusted for this correction were then compared with the wire depths and depths determined from pressure thermometers at the twenty oceanographic stations where such measurements were made. Of the twenty comparisons, the one made on Merriam Ridge (station 67) has been omitted because of the steep bottom slope in this vicinity. Because of the great distances between shotgun soundings, there is no way of telling when the bottom was regular and when irregular except in the previously mentioned case of Merriam Ridge. Therefore, as the shotgun soundings and accepted depths are only approximately simultaneous, a greater scatter must be expected than was found in the comparison of sonic depth finder soundings with accepted depths. A greater scatter must also be expected because a stop watch measurement of echo time is not as precise as an echo time measured by the sonic depth finder. Table 4 gives the approximately simultaneous depths as determined by wire and pressure thermometers and as given by the shotgun soundings corrected for greater intial velocity.

Comparison of the shotgun depths with corresponding wire and thermometer depths shows the shotgun soundings consistently greater (see fig. 1). The mean shotgun depth for the nineteen cases, excluding station 67, is 3621 meters, and the mean wire depth is 3471 meters, giving a ratio of means of 0.958+. The mean of the single ratios is 0.960- with a probable error of ±0.006.

In view of this a timing factor of 0.958 has been adopted and used for the correction of shotgun soundings after they were adjusted for the greater initial velocity resulting from the explosive character of the source of the sound. This makes the assumption that the stop watch had a large gaining rate. In May 1928 the stop watch was compared with a chronometer at the beginning and end of a two-hour run, and it checked so closely that it was considered permissible to use it as a time standard in the calibration of the depth finder timing. The depth finder was then adjusted until it was in agreement with the stop watch over a period of about fifteen minutes. The depth finder was similarly adjusted in February 1929 after it had been repaired and overhauled. The same stop watch was used in measuring the echo times for the shotgun soundings. In all three instances, that is, during the period from May 1928 to February 1929, the period from February 1929 to November 1929, and in the shotgun

Table 2. Summary of comparison between sonic depths and thermometer or wire depths at stations 78 to 162

Group	No. of cases	Mean depth in meters		Ratios of mean depths	Means of single ratios and their probable errors
		Sonic	True		
Depth by thermometer, bottom regular	12	4680	4510	0.964	0.963 ±0.0029
Depth by thermometer, bottom irregular	14	4796	4610	0.961	0.960 ±0.0038
Depth by wire, bottom regular	12	4825	4650	0.964	0.964 ±0.0035
Depth by wire, bottom irregular	9	4591	4401	0.959	0.957 ±0.0061
Bottom regular	24	4752	4580	0.964	0.963 ±0.0022
Bottom irregular	23	4716	4528	0.960	0.959 ±0.0032
Depth by thermometer	26	4742	4564	0.962	0.962 ±0.0024
Depth by wire	21	4724	4543	0.962	0.961 ±0.0032
All values	47	4734	4555	0.962	0.961 ±0.0019

Table 3. Showing difference in time required for first and succeeding echoes

Sounding no.	Time of		Mean time of			Sounding no.	Time of		Mean time of		
	First echo	First two echoes	First echo	Second echo	Difference		First echo	First two echoes	First echo	Second echo	Difference
363	3.2	9.6	3.2	6.4	+3.2[a]	441	4.7	9.6	.....	.....	....
364	5.2	10.4	.....	.....	....		4.6	9.6	4.65	4.95	+0.30
	5.3	10.1	5.25	5.00	-0.25	445	4.3	8.7	.....	.....	....
366	5.5	12.2	5.5	6.7	+1.2[b]		4.2	8.6	4.25	4.40	+0.15
369	4.5	9.5	.....	.....	....	446	4.7	9.7	4.7	5.0	+0.3
	4.5	9.8	4.50	5.15	+0.65[a]	447	5.0	10.2	5.0	5.2	+0.2
378	4.0	7.9	4.0	3.9	-0.1	450	4.8	10.1	.....	.....	....
379	4.0	7.5	.....	.....	....		4.9	10.2	4.85	5.30	+0.45
	3.8	7.7	3.90	3.70	-0.20	451	4.8	9.8	.....	.....	....
380	4.2	8.2	4.2	4.0	-0.2		4.8	9.9	4.80	5.05	+0.25
393	4.2	8.2	.....	.....	....	452	4.8	9.8	.....	.....	....
	3.9	8.2	.....	.....	....		4.7	9.7	4.75	5.00	+0.25
	4.4	8.6	4.17	4.17	±0.00	453	5.0	10.3	5.0	5.3	+0.3
395	4.5	9.0	.....	.....	....	460	1.8	3.5	.....	.....	....
	4.4	8.9	4.45	4.50	+0.05		1.5	3.5	1.65	1.85	+0.20
396	4.0	8.5	4.0	4.5	+0.5	463	5.5	11.0	5.5	5.5	±0.00
397	3.8	7.6	3.8	3.8	±0.00	464	5.5	11.1	5.5	5.6	+0.1
403	3.5	7.7	3.5	4.2	+0.7	466	5.8	11.4	.....	.....	....
414	4.2	8.7	.....	.....	....		5.8	11.6	5.80	5.70	-0.10
	4.2	8.3	4.20	4.30	+0.10	467	5.8	11.5	.....	.....	....
421	5.2	10.4	5.2	5.2	±0.00		5.5	11.2	5.65	5.70	+0.05
431	5.0	10.1	5.0	5.1	+0.1	470	5.	10.1	.....	.....	....
432	5.2	10.0	5.2	4.8	-0.4		5.6	10.1	5.05	5.05	±0.00
438	4.8	10.2	.....	.....	....	472	5.8	11.7	.....	.....	....
	5.2	10.2	5.00	5.20	+0.20		5.6[c]	11.8	5.70	6.05	+0.35
440	4.7	.....	.....	.....	....	475	3.1[c]	3.9[d]	0.70	0.80	+0.10
	....	9.5	4.7	4.8	+0.1						
										Mean and probable error=	+0.113 ±0.028

[a] Time questioned in original record. [b] Time of second echo apparently in error by one second.
[c] Time for first four echoes. [d] Time for first five echoes.

soundings, the ratios of true depth to indicated sonic depth have been of the same order of magnitude and less than unity. This can probably be reconciled with the comparison of stop watch and chronometer by considering that the stop watch had a faster rate during the first part of a run than during the latter part, such as the second hour, and that the initial fast rate was maintained during the first fifteen minutes. This seems to be be a reasonable assumption, and on such a basis the differences between the timing factors found for the shotgun soundings and the first and second periods of the sonic depth finder are attributed to the changing rate of the stop watch. Viewed in this light it is to be noted that when these three timing factors are plotted against time they fall practically on a straight line. Such a plot is shown in figure 2, in which the date of the first adjustment of the depth finder is taken as May 28, 1928; the date of the shotgun ratio is taken as the mean date of the comparisons on which it is based, December 19, 1928; and the date of the second adjustment of the depth finder is taken as February 19, 1929.

These timing factors place the shotgun soundings and the sonic depth finder soundings all on a common basis, which is referred to the unprotected deep-sea reversing thermometers for a standard of depth.

Table 4. Comparison between shotgun soundings and soundings by wire or unprotected thermometers

Station no.	Depths in meters			Ratios	
	Wire	Ther-mometer	Shotgun	Wire to shotgun	Thermometer to shotgun
43	3352	......	3716	0.902	....
46	2905	2840	2999	0.969	0.947
47	3080	......	2999	1.027	....
49	3028	......	3187	0.950	....
51	3063	2898	3180	0.963	0.911
52	2801	2851	2899	0.966	0.983
54	3063	......	3147	0.973	....
56	3135	......	3409	0.920	....
57	3139	......	3294	0.953	....
59	4116	......	4355	0.945	....
60	4007	......	4087	0.980	....
61	3299	......	3518	0.938	....
62	3610	......	3823	0.944	....
63	3393	......	3446	0.985	....
64	3820	3879	3880	0.985	1.000
65	3580	3626	3659	0.978	0.991
67	1085	1089	1278[a]	....	....
68 68	4146 4166	......	4309	0.964	....
69	3657	......	3845	0.951	....
70	4739	......	5054	0.938	....
			Average	0.960 ±0.006	

[a] Merriam Ridge

<u>Note</u>.--Omitting station 67, we have the following average ratios of depths: wire to shotgun, 0.958; wire and thermometer where available, to shotgun, 0.957; thermometer to shotgun, 0.969; wire to shotgun at stations where thermometer depths are available, 0.973.

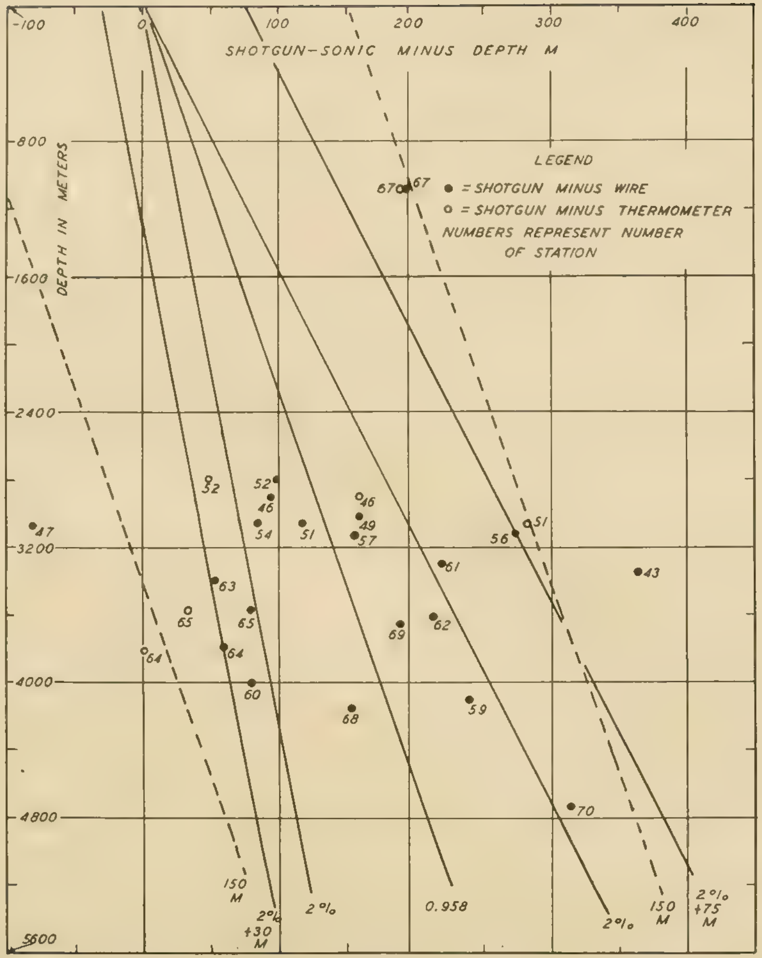


FIG. 1—COMPARISON OF SHOTGUN DEPTHS WITH CORRESPONDING WIRE AND THERMOMETER DEPTHS

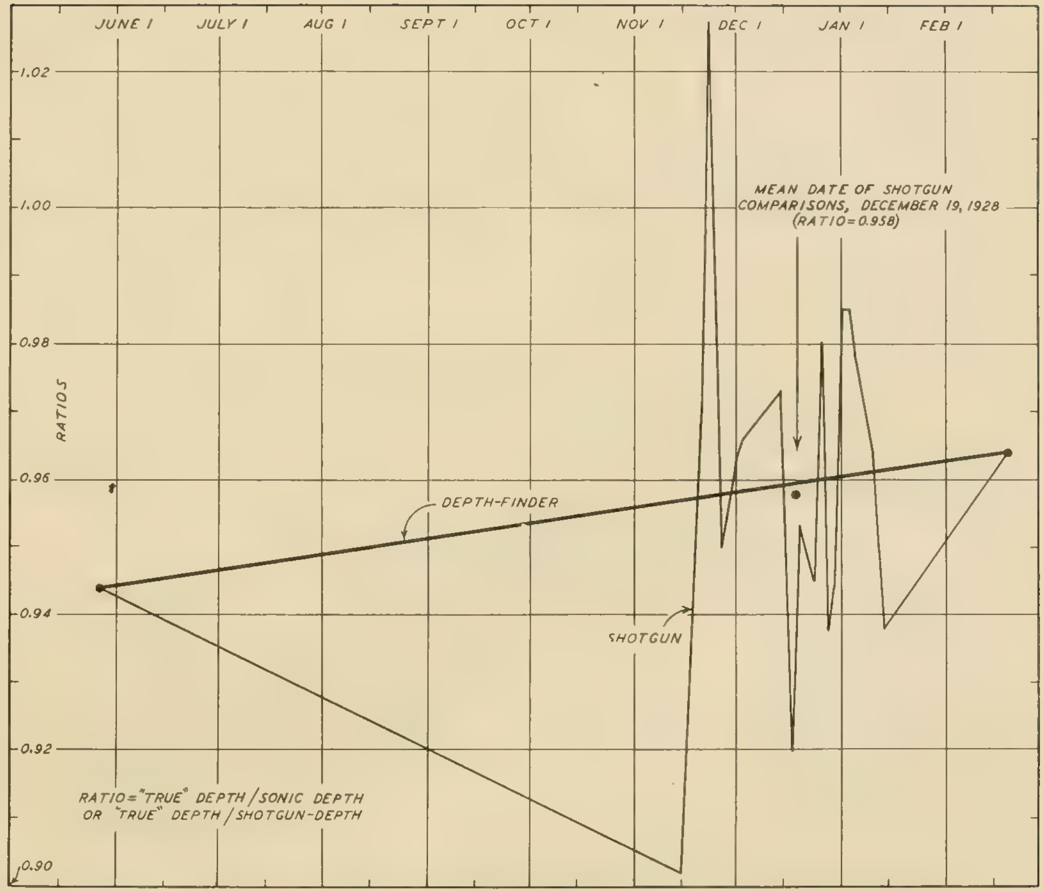


FIG. 2—VARIATION OF TIMING FACTOR OF SONIC DEPTH FINDER FROM MAY 28, 1928 TO FEBRUARY 19, 1929

SOUNDING VELOCITY

By sounding velocity is meant the average velocity of sound over a vertical path from the sea surface to the depth in question. As the sounding velocity is dependent on the actual velocity at intervals along the vertical path and as the actual velocity is a function of the temperature, salinity, and pressure, a knowledge of the vertical distribution of temperature and salinity is necessary before the sounding velocity at any point can be computed. The vertical distribution of temperature and salinity was determined from actual measurements at each oceanographic station (that is, about every other day) down to depths which were usually from 2000 to 4000 meters. The deep-water observations indicated that certain of the oceanographic stations had vertical temperature and salinity distributions sufficiently similar to be grouped together. Accordingly, all measured values below 2000 meters for a given group of stations were plotted on a single graph which was used for extrapolating the individual temperature and salinity curves for stations within that group. Scaled values of temperature and salinity for the nominal depth intervals down to 2500 meters are given for each oceanographic station in table 2 (see Oceanography I-B). Extrapolated values for depths below 2500 meters as determined by groups are shown in table 1. Wherever the vertical distribution curves based on actual measurements extend below 2500 meters, values scaled from these curves have been used instead of the values obtained from group extrapolation. The sounding velocities computed from the conditions found to exist at the oceanographic stations are given in table 5 (Oceanography I-B). In this table the values appearing below the heavy line are based on extrapolated temperatures or salinities. The sounding velocities given are probably significant to a few tenths of a meter per second as representing the conditions at the time measurements were made, but must not be relied on as representing the conditions at any other time.

There are seasonal variations in both temperature and salinity in the upper layers. Of these, the variations in temperature have the greater effect on sound velocity. In general, the temperate regions suffer the greatest annual variations in surface temperature, whereas the tropics and polar regions have smaller changes. Surface temperatures may vary as much as 10° C in the temperate regions and even more in the vicinity of the boundaries of pronounced streams such as the Japan Current and the Gulf Stream. Little is known regarding subsurface variations in temperature in the open ocean. It seems reasonable, however, to expect that annual variations occur to depths as great as those at which the rapid temperature decrease of the thermocline changes to the gradual temperature decrease at greater depths. Let us assume, then, that significant annual variations in temperature occur down to 500 meters and that the temperature at the surface may be 10° C different from the values measured on the Carnegie. Under such conditions the values of sounding velocity given in table 5 (Oceanography I-B) would be in error by about 0.2 per cent at a depth of 2500 meters and the error at 4000 meters would be about 2 meters per second.

Vertical sections showing the sounding velocity along the path of the Carnegie have been prepared from the computed values given in table 5 (Oceanography I-B). These sections are approximately south-north and west-east, but the abscissas represent great circle distances between oceanographic stations. In order to show the variations, the vertical distances are shown on a scale which magnifies them 1000 times with respect to the horizontal scale. It is believed that sounding velocities shown in these sections, particularly in the Pacific, can be used to reduce future soundings in depths greater than 2500 meters not in the vicinity of pronounced streams with an error of less than one-fifth per cent in the sounding velocity. A horizontal section showing the sounding velocity at a level of 4000 meters (fig. 1) is given for the Pacific. An inspection of this indicates that the sounding velocities represented by the vertical sections can be applied to areas adjacent to the actual sections as follows: sections IV, VIII, X, XI, XII, and XIII apply 200 miles on each side; sections III, V, VI, XV, and XVI apply 100 miles on each side; sections VII, IX, and XIV apply 50 miles on each side.

In the British Admiralty Hydrographic Department Publication No. 282 entitled "Tables of the velocity of sound in pure water and sea-water for use in echo-sounding and sound-ranging" the oceans are divided into twenty-three areas within which echo soundings may be roughly reduced by means of appropriate tables of sounding velocity. The boundaries between these areas were intersected a number of times by the path of the Carnegie and the accompanying vertical sections consequently represent additional data on which to base the location of these boundaries. The boundary conditions were assumed to be the means of the sounding velocities given in the British Admiralty tables as applicable, at given depths, to the two adjacent areas. These boundary conditions were then located on the vertical sections, more attention being paid to the deeper layers than to the layers above the minimum. The boundary locations, as indicated by the Carnegie sections, are shown by broken lines superimposed on a chart giving the British Admiralty boundaries. This is shown in figures 2 and 3. The boundary between areas 17 and 3 is shifted somewhat to the south. Boundary 6 to 3 could not be very well located and has been omitted. Boundary 3 to 10 is shifted nearly 5° to the north. In the Pacific, boundary 18 to 20 seems to be south of the south end of Section III and east of the east end of Section X. Boundary 16 to 18, off the South American coast, is also shifted to the south. The eastern tip of boundary 16 to 13 is shifted westward through about 20° of longitude. Boundary 9 to 13 is apparently south and west of the Samoan Islands. The southern boundary of area 15 is shifted south and its northern boundary is shifted north. Boundary 13 to 16, north of Guam, is shifted south. Boundary 16 to 18, off the Japanese coast, is practically the same, and boundary 18 to 19 in this vicinity is the same. Boundary 19 to 21, however, is shifted considerably south, being south of the entire Section XVI. In view of this it seems probable that the northward bulge of boundary 18 to 19 is not so pronounced. The eastern end of boundary 18 to 19 is shifted but slightly to the south. Boundary 16 to 18 has an irregularity introduced northeast of the Hawaiian Islands. The boundary between areas 13 and 16, southeast of the Hawaiian Islands, could not be very well located on Section V. It seems probable that the values of

Table 1. Group extrapolation

Depth	3, 4, 5, 6, 10, and 11		12		14		2 and 15		16 to 19	
	Temp.	Salin.	Temp.	Salin.	Temp.	Salin.	Temp.	Salin.	Temp.	Salin.
m	°C	o/oo	°C	o/oo	°C	o/oo	°C	o/oo	°C	o/oo
3000	2.90	34.91	2.35	34.91	2.90	34.90	3.15	34.92	2.80	34.90
3500	2.80	34.90	2.30	34.90	2.55	34.89	2.80	34.91	2.65	34.89
4000	2.70	34.90	.....	....	2.25	34.89	2.50	34.90	2.60	34.88
4500	2.60	34.89	.....	....	2.20	34.88	2.40	34.88	2.50	34.87
5000	2.50	34.89	.....	....	.....	....	2.35	34.85	2.45	34.85
5500	2.45	34.88	.....	....	.....	....	2.25	34.83	2.40	34.83
6000	.....	....	.....	....	.....	....	2.20	34.82	2.35	34.82
6500	.....	....	.....	....	.....	....	.....	....	.....	....
Depth	58 to 62		63 to 67		47 and 68 to 79		80 to 92		93 to 94 and 160 to 162	
3000	1.75	34.69	1.75	34.66	1.80	34.68	1.70	34.66	1.70	34.66
3500	1.35	34.69	1.70	34.66	1.80	34.68	1.60	34.67	1.60	34.67
4000	1.10	34.69	1.70	34.67	1.80	34.68	1.45	34.67	1.40	34.67
4500	1.10	34.69	1.70	34.67	1.80	34.68	1.35	34.67	1.10	34.67
5000	1.10	34.69	1.70	34.67	1.80	34.68	1.30	34.67	1.10	34.67
5500	.....	....	.....	....	1.80	34.68	1.20	34.67	1.10	34.67
6000	.....	....	.....	....	1.80	34.68	1.15	34.67	1.10	34.67
6500	.....	....	.....	....	.....	....	1.15	34.67	.....	....
7000	.....	....	.....	....	.....	....	.....	....	.....	....
7500	.....	....	.....	....	.....	....	.....	....	.....	....
8000	.....	....	.....	....	.....	....	.....	....	.....	....
8500	.....	....	.....	....	.....	....	.....	....	.....	....
9000	.....	....	.....	....	.....	....	.....	....	.....	....

(Salinity values probably 0.03 o/oo too low; see page 72)

sounding velocity for either area 13 or 16 should be revised. The shifted boundaries are shown by broken lines of appreciable length, although only a single point is located at each crossing. To show these single points more definitely, lines have been drawn connecting the two oceanographic stations nearest each of these points of intersection.

As shown in one of the preceding sections (pp. 50-53), correction had to be applied to the sonic depths, owing to error in the timing, by multiplying the computed depths from various parts of the cruise by a constant factor. This has been done and the final values, together with their positions, are given in table 4 (Oceanography I-B).

It is believed that, except where otherwise noted in this table, the soundings are accurate within the following limits: soundings 0 to 360 inclusive, ±1.0 per cent; soundings 361 to 476 inclusive, ±1.5 per cent; soundings 477 to 534 inclusive, ±1.0 per cent; and soundings 535 to 1496 inclusive, ±0.5 per cent.

The sonic soundings listed in table 4 (Oceanography I-B) are nearly all shown graphically in twenty-eight bottom profiles, of which twelve have been plotted against latitude and sixteen have been plotted against longitude. The course followed by the Carnegie has been shown on each profile.

of temperature and salinity

Station number											
20 to 30		31 to 34		35 to 38		39 to 45		46 and 48 to 50		51 to 57	
Temp.	Salin.	Temp.	Salin.	Temp.	Salin.	Temp.	Salin.	Temp.	Salin.	Temp.	Salin.
°C	°/oo	°C	°/oo	°C	°/oo	°C	°/oo	°C	°/oo	°C	°/oo
2.80	34.91	4.05	34.72	2.05	34.63	1.70	34.66	1.90	34.66	1.80	34.66
2.60	34.90	4.05	34.72	2.15	34.63	1.65	34.67	1.85	34.67	1.75	34.67
2.45	34.89	4.05	34.72	2.25	34.63	1.60	34.67	1.80	34.67	1.70	34.67
2.30	34.87	4.05	34.72	2.30	34.63	1.55	34.67	.....	....	.....	....
2.20	34.85	4.05	34.72	2.40	34.63	1.55	34.67	.....	....	.....	....
2.10	34.83	4.05	34.72	.....	....	.....	....	.....	....	.....	....
2.00	34.82	.....	....	.....	....	.....	....	.....	....	.....	....
1.90	34.81	.....	....	.....	....	.....	....	.....	....	.....	....
95 to 100		101 to 108		109 to 129		130 to 149		150		151 to 159	
1.70	34.64	1.65	34.64	1.60	34.64	1.60	34.64	1.65	34.65	1.75	34.65
1.65	34.65	1.60	34.65	1.55	34.64	1.50	34.64	1.55	34.66	1.55	34.66
1.60	34.65	1.60	34.65	1.55	34.64	1.55	34.65	1.40	34.65	1.40	34.65
1.60	34.65	1.55	34.65	1.55	34.64	1.55	34.65	1.40	34.64	1.40	34.64
1.55	34.66	1.55	34.66	1.55	34.64	1.50	34.65	1.50	34.64	1.50	34.64
1.55	34.66	1.55	34.66	1.55	34.64	1.60	34.65	1.35	34.64	1.35	34.64
1.60	34.66	1.60	34.66	1.60	34.64	1.65	34.65	1.20	34.64	1.20	34.64
1.70	34.67	1.70	34.67	1.70	34.64	1.70	34.65	.....	....	1.10	34.64
.....	....	1.75	34.67	1.75	34.64	.....	....	.....	....	.....	....
.....	....	1.85	34.67	1.85	34.64	.....	....	.....	....	.....	....
.....	....	1.90	34.67	1.90	34.64	.....	....	.....	....	.....	....
.....	....	2.00	34.67	2.00	34.64	.....	....	.....	....	.....	....
.....	....	.....	....	2.05	34.64	.....	....	.....	....	.....	....

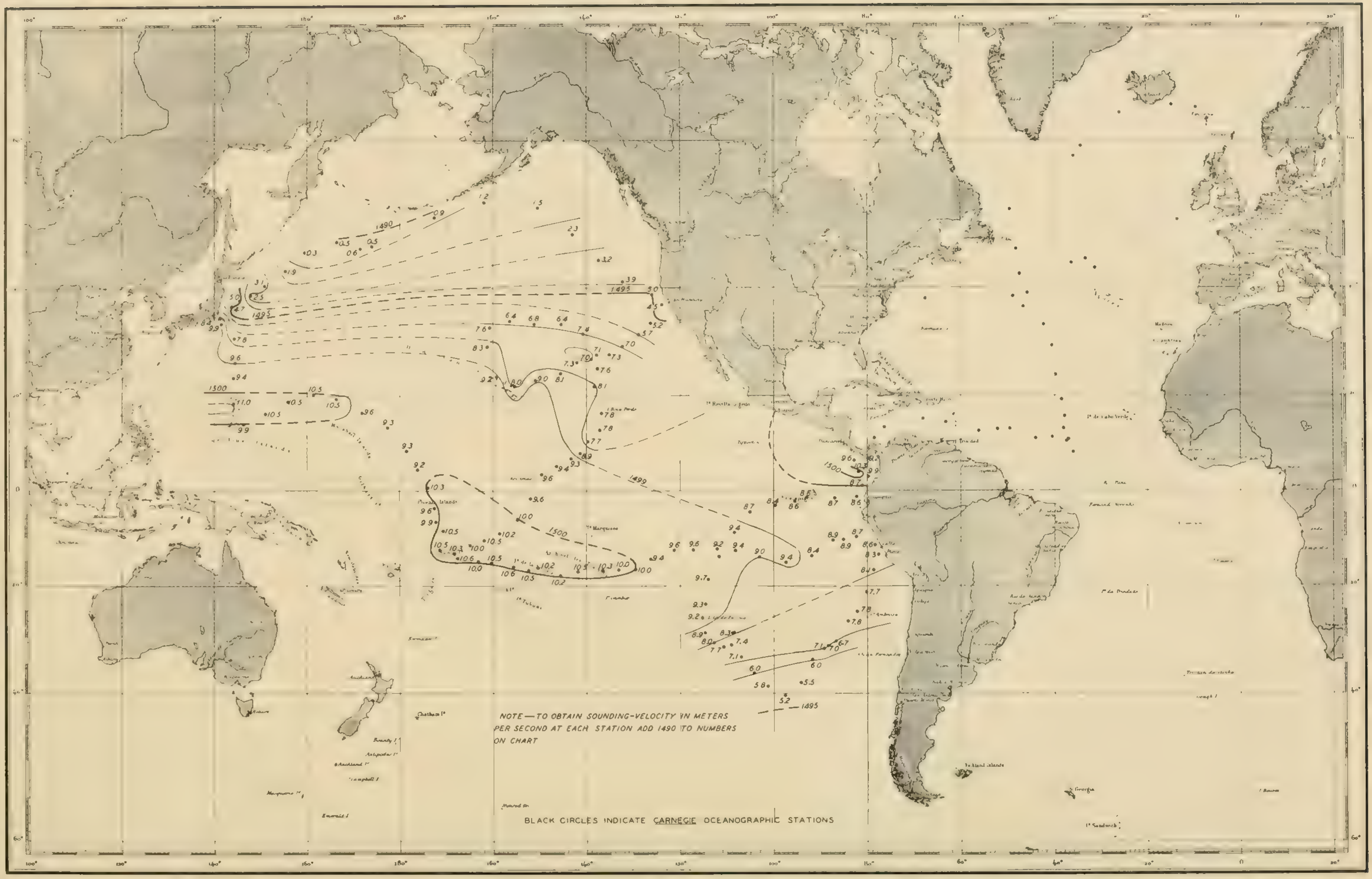


FIG. 1—HORIZONTAL DISTRIBUTION SOUNDING VELOCITY AT 4000 METERS, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928-1929

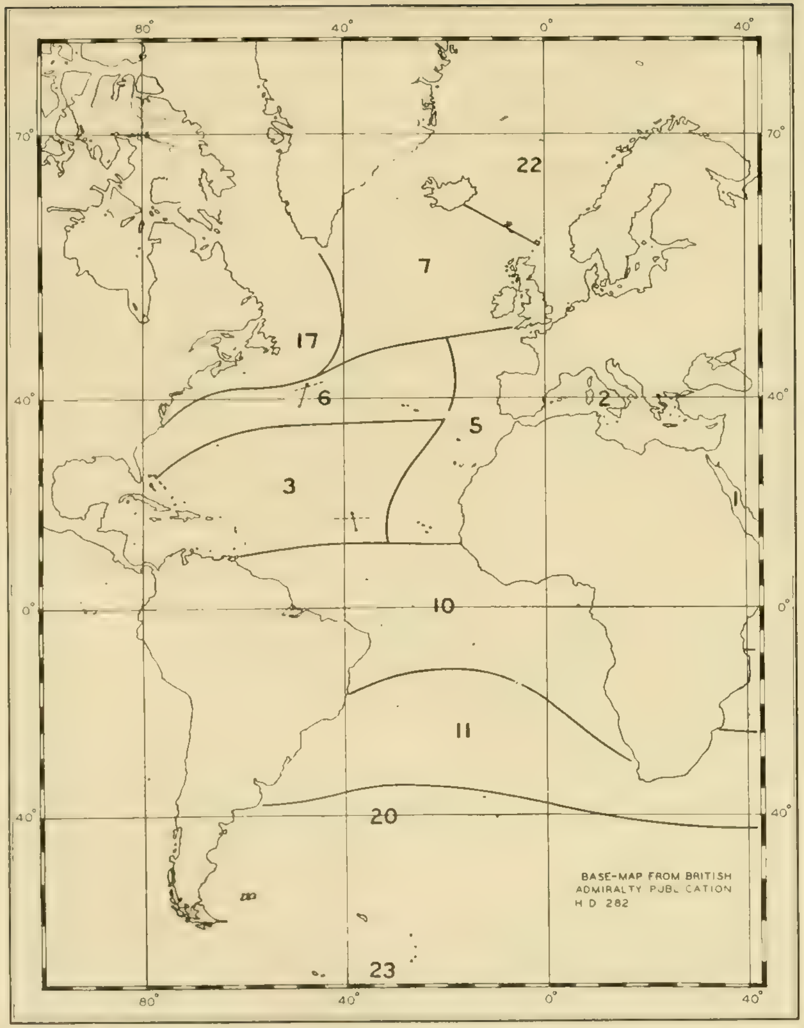


FIG 2 – AREAS SIMILAR SOUNDING VELOCITY CHARACTERISTICS, ATLANTIC OCEAN, FROM CARNEGIE RESULTS, 1928–1929

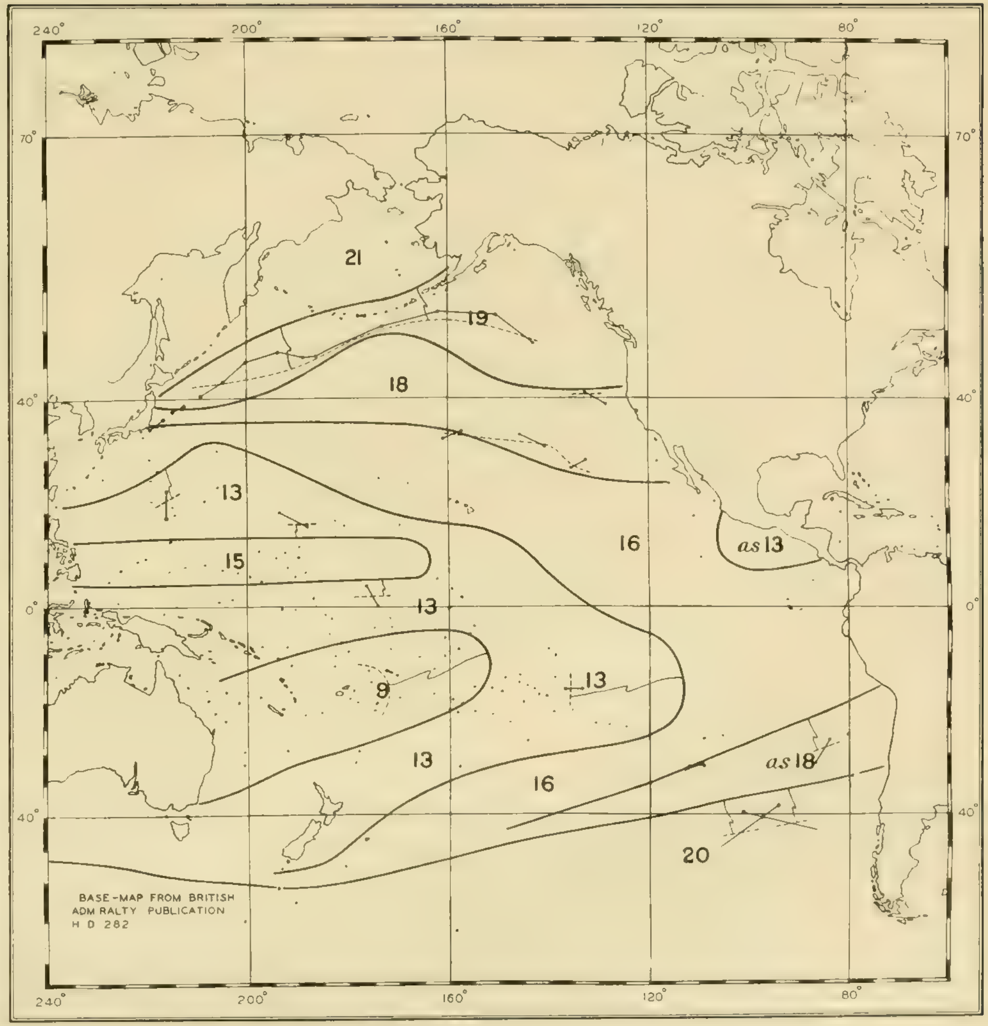


FIG 3 – AREAS SIMILAR SOUNDING VELOCITY CHARACTERISTICS, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928–1929

The salinities were measured by the conductivity method using a Wenner salinity bridge (Wenner, Smith, and Soule, 1930). This instrument was of the type designed by Dr. Frank Wenner, of the Bureau of Standards, originally for the International Ice Patrol Service. It consists essentially of an alternating current Wheatstone's bridge, two adjacent arms of the bridge being formed by two similar electrolytic cells, the other two arms being made up of two fixed coils of manganin wire between which is a slide wire. The electrolytic cells are immersed in a stirred water bath which is thermostatically controlled at constant temperature. A substitution method is employed so that cell constants and absolute conductivities need not be known. Sea water, the salinity of which is unimportant within limits, is placed in one of the cells and sea water of known salinity is placed in the other cell. A small resistance in series with the first cell is then adjusted until the bridge is balanced when the slide-wire reading corresponds to the salinity of the known sample. This sample is then withdrawn and replaced by the unknown sample which is to be measured. The bridge is balanced this time by the adjustment of the slide wire, thus giving the conductivity of the unknown in terms of the known. The conductivities may be converted into salinities, but it is customary to calibrate the instrument by the measurement of a number of samples of known salinity so that the slide-wire reading may be converted directly into salinity without a knowledge of the relation between salinity and conductivity.

It can be assumed that the relation between salinity and conductivity is linear, but not proportional, over the range encountered in sea water. On this assumption the relation between slide-wire readings and salinity in an instrument of this sort can be expressed by an equation of the type

$$S = S' \left[1 + A(s - s') + B(s - s')^2 + C(s - s')^3 \ldots\right] \qquad (1)$$

in which s is the slide-wire reading corresponding to any salinity S, and s′ is the slide-wire reading corresponding to the salinity S′, and A, B, C, ... are numerical constants depending on s′, S′, the relation between salinity and conductivity, and the constants of the bridge circuit. The numerical limits of the salinity range of such an instrument are fixed by the ratio of the resistance of one division of the slide wire to the resistance of the two bridge arms which include the slide wire, and by the arbitrary selection of the slide-wire reading s′ which will correspond to the salinity S′. In the Carnegie instrument the slide wire had 1000 divisions, each of which had a resistance of 1/15,000 of the sum of the resistances of the two adjacent bridge arms which included the slide wire. Under these conditions, terms in equation (1) involving (s - s′) to exponents greater than 3 are negligibly small and the third-degree term need only be considered when (s - s′) is numerically large. When s′ is selected near the middle of the slide wire, the second-degree equation can be used with negligible error.

In the case of this instrument a slide-wire reading s′ of 699.5 was selected as corresponding to a salinity S′ of 35.00 per mille, so that a second-degree equation can be used to express the calibration curve. If any irregularities existed in the slide wire the calibration curve would have had departures from the curve of such an equation since the development of the equation assumes direct proportionality between slide-wire reading and slide-wire resistance.

Time did not permit of a test being made for uniformity of the slide wire before the departure of the Carnegie in May 1928. The preliminary calibration of the bridge was therefore made in the following manner. Standard water from the International Bureau at Copenhagen having a salinity of 34.99 per mille was placed in the test cells and the bridge was balanced with the slide wire set at a reading of 698.5. The slide-wire readings at balance were then determined for five other samples of known salinity furnished by the Scripps Institution of Oceanography, and titrated against Copenhagen standard water by H. R. Seiwell. A curve was then drawn through these six well-distributed points. From time to time, as the cruise progressed, some of the samples which were measured in the bridge were also titrated against standard water in a Knudsen burette by the silver nitrate method. Each of these samples furnished an additional point on the calibration curve. All such points ultimately obtained are shown in figure 1. The origin of these samples and the comparison values are given in table 1.

Because of the considerable range of room temperature encountered in a cruise such as that of the Carnegie, two regulating temperatures were provided for. In colder weather the water bath was regulated at a temperature of about 30° C and in the tropics a temperature of about 40° C was used. In the hope that the slope and curvature of the calibration curve at 40° C would be practically the same as for 30° C, the same arbitrary point, namely, salinity 34.99 per mille at slide-wire reading 698.5, was selected for each temperature. The points determined at a regulating temperature of 30° C are shown in figure 1 by circles and those determined at 40° C by crosses. The arbitrarily selected point is shown as a solid circle and cross. As there were no systematic differences between the points determined at the two temperatures, all points could be used in determining the calibration curve. This meant further that the exact temperature of regulation was unimportant as long as it did not change materially during a series of measurements.

Figure 1 includes all comparisons made on the Carnegie between bridge and titration methods. None was discarded. It includes all differences arising from both instrumental and observational error in both bridge and titration measurements, as well as any differences arising from variation in salt ratios in samples from different localities. As an individual bridge measurement is accurate to about 0.01 to 0.02 per mille salinity, and as an individual titration is subject to a similar error, it was expected that the points would scatter over from 0.02 to 0.04 per mille on each side of a smooth curve.

The second-degree equation whose curve fits the points shown in figure 1 is

$$S = 35\left[1 + 295.7 \times 10^{-6}(s - 699.5) + 46. \times 10^{-9}(s - 699.5)^2\right] \qquad (2)$$

The slide-wire readings of all the points shown in figure 1 were converted into salinities by this equation and their differences from the titration values plotted against

Table 1. Titration comparisons used in calibration of salinity bridge

Date		Station no.	Latitude	Longitude	Depth	Salinity by titration	Slide-wire reading	Nominal regulating temperature
Bridge	Titration							
1928	1928		° ′	° ′	m	‰		°C
July 15	....	8	63 30.1 N	14 40.7 W	0	35.23	720.6	30
15	....	8	63 30.1 N	14 40.7 W	300	35.26-	722.6	30
15	....	8	63 30.1 N	14 40.7 W	1000	35.09	708.5	30
Aug. 1	Aug. 7	11	58 12.1 N	35 51.4 W	581	34.93	692.2	30
5	7	12	51 39.8 N	49 31.7 W	435	34.82	685.6	30
16	....	Prepared sample				33.48	547.6	40
16	....	Prepared sample				36.20	809.5	40
Oct. 8	Oct. 9	33	13 37.2 N	76 22.5 W	661	34.74	674.8	40
26	27	35	6 32.5 N	80 04.1 W	27	33.50	554.7	40
Nov. 3	....	38	3 45.8 N	81 36.8 W	0	32.86	488.0	40
3	....	38	3 45.8 N	81 36.8 W	47	34.20	624.1	40
3	....	38	3 45.8 N	81 36.8 W	516	34.60	662.5	40
10	Nov. 10	41	1 36.6 S	86 58.2 W	6	34.19	621.0	30
10	10	41	1 36.6 S	86 58.2 W	23	34.53	653.6	30
10	10	41	1 36.6 S	86 58.2 W	323	34.83	682.3	30
13	14	42	1 32.2 S	93 09.7 W	0	34.70	672.6	30
13	14	42	1.32.2 S	93 09.7 W	578	34.59	661.7	30
13	14	Evaporimeter sample				34.41	642.0	30
19	19	45	4 35.1 S	105 03.4 W	238	34.87	689.1	30
19	19	45	4 35.1 S	105 03.4 W	310	34.86+	684.8	30
19	19	45	4 35.1 S	105 03.4 W	1176	34.60-	685.1	30
21	22	46	9 06.3 S	108 19.6 W	6	35.35	728.0	30
21	22	46	9 06.3 S	108 19.6 W	74	35.37	733.0	30
21	22	46	9 06.3 S	108 19.6 W	146	35.43	737.4	30
23	24	47	14 07.4 S	111 50.4 W	0	35.99-	787.3	30
23	24	47	14 07.4 S	111 50.4 W	5	35.99+	785.2	30
23	24	47	14 07.4 S	111 50.4 W	53	35.95	789.6	30
23	24	47	14 07.4 S	111 50.4 W	77	36.06-	795.3	30
23	24	47	14 07.4 S	111 50.4 W	95	36.15	805.6	30
23	24	47	14 07.4 S	111 50.4 W	205	35.70+	764.4	30
23	24	47	14 07.4 S	111 50.4 W	314	34.54-	657.8	30
23	24	47	14 07.4 S	111 50.4 W	425	34.62+	660.3	30
23	24	47	14 07.4 S	111 50.4 W	2044	34.63+	664.0	30
Dec. 5	Dec. 6	53	29 06.5 S	108 44.4 W	4	35.67	762.3	30
5	6	53	29 06.5 S	108 44.4 W	44	35.765	769.2	30
5	6	53	29 06.5 S	108 44.4 W	174	35.12+	713.6	30
5	6	53	29 06.5 S	108 44.4 W	309	34.75-	678.5	30
5	6	53	29 06.5 S	108 44.4 W	360	34.55-	655.2	30
5	6	53	29 06.5 S	108 44.4 W	543	34.32	635.2	30
5	6	53	29 06.5 S	108 44.4 W	794	34.28	631.0	30
5	6	53	29 06.5 S	108 44.4 W	1238	34.44-	649.1	30
5	6	Evaporimeter sample				35.70	766.0	30
26	26	Evaporimeter sample				37.68	948.6	30
26	26	Evaporimeter sample				37.23	906.0	30
26	26	60	40 23.9 S	97 32.7 W	0	33.93-	594.2	30
26	26	60	40 23.9 S	97 32.7 W	70	33.99	605.2	30
26	26	60	40 28.9 S	97 32.7 W	92	33.97	603.5	30
26	26	60	40 23.9 S	97 32.7 W	185	34.11	618.0	30
26	26	60	40 23.9 S	97 32.7 W	712	34.22	625.7	30
26	26	60	40 23.9 S	97 32.7 W	2600	34.63+	666.2	30
1929	1929							
Jan. 7	Jan. 8	66	27 04.4 S	84 01.1 W	6	34.70	670.2	30
7	8	66	27 04.4 S	84 01.1 W	48	34.79	680.0	30
7	8	66	27 04.4 S	84 01.1 W	96	34.94	694.9	30
7	8	66	27 04.4 S	84 01.1 W	193	34.50	653.8	30
7	8	66	27 04.4 S	84 01.1 W	293	34.41	645.4	30
7	8	66	27 04.4 S	84 01.1 W	391	34.45	647.2	30
7	8	66	27 04.4 S	84 01.1 W	751	34.37	639.9	30
7	8	66	27 04.4 S	84 01.1 W	1617	34.57	658.2	30
7	8	66	27 04.4 S	84.01.1 W	2606	34.63	666.8	30
7	8	Evaporimeter sample				37.59	939.8	30
Feb. 18	Feb. 18	77	14 20.0 S	103 12.5 W	0	36.04	794.5	30
18	18	77	14 20.0 S	103 12.5 W	69	36.02	793.1	30
18	18	77	14 20.0 S	103 12.5 W	92	35.97	791.0	30
18	18	77	14 20.0 S	103 12.5 W	182	35.43	736.8	30
18	18	77	14 20.0 S	103 12.5 W	2721	34.65	668.8	30
24	25	80	12 39.0 S	117 22.1 W	5	35.91	785.1	30
24	25	80	12 39.0 S	117 22.1 W	22	35.91	787.1	30
24	25	80	12 39.0 S	117 22.1 W	44	35.92	786.3	30
24	25	80	12 39.0 S	117 22.1 W	66	36.04	795.7	30
24	25	80	12 39.0 S	117 22.1 W	88	36.19	812.6	30
24	25	80	12 39.0 S	117 22.1 W	133	36.31-	820.6	30
24	25	80	12 39.0 S	117 22.1 W	180	35.82+	778.6	30
24	25	80	12 39.0 S	117 22.1 W	226	35.17	719.1	30
24	25	80	12 39.0 S	117 22.1 W	840			

Table 1. Titration comparisons used in calibration of salinity bridge--Continued

Date		Sta-tion no.	Latitude	Longitude	Depth	Salinity by titration	Slide-wire reading	Nominal regulating temperature
Bridge	Titration							
1929	1929		° ′	° ′	m	o/oo		°C
Feb. 24	Feb. 25	80	12 39.0 S	117 22.1 W	840	34.45	650.3	30
24	25	Evaporimeter sample				36.02	793.5	30
Mar. 2	Mar. 3	Evaporimeter sample				36.33	828.4	30
2	3	83	17 00.4 S	129 45.0 W	49	36.50	842.0	30
2	3	83	17 00.4 S	129 45.0 W	73	36.41	835.5	30
2	3	83	17 00.4 S	129 45.0 W	98	36.26	820.0	30
2	3	83	17 00.4 S	129.45.0 W	146	36.28	823.9	30
2	3	83	17 00.4 S	129 45.0 W	244	35.52	751.9	30
2	3	83	17 00.4 S	129 45.0 W	645	34.39	644.2	30
4	5	84	17 11.4 S	133 17.6 W	0	36.24	814.8	30
4	5	84	17 11.4 S	133 17.6 W	23	36.35	826.7	30
4	5	84	17 11.4 S	133 17.6 W	71	36.43+	835.2	30
4	5	84	17 11.4 S	133 17.6 W	190	36.17+	810.2	30
4	5	84	17 11.4 S	133 17.6 W	333	34.73	676.9	30
27	28	91	15 44.3 S	160 25.3 W	0	35.15	712.0	40
27	28	91	15 44.3 S	160 25.3 W	20	35.17	714.5	40
27	28	91	15 44.3 S	160 25.3 W	66	35.79	769.7	40
27	28	91	15 44.3 S	160 25.3 W	86	35.91	783.7	40
27	28	91	15 44.3 S	160 25.3 W	173	36.03	791.6	40
27	28	91	15 44.3 S	160 25.3 W	261	35.61	754.5	40
27	28	91	15 44.3 S	160 25.3 W	615	34.41	641.4	40
27	28	91	15 44.3 S	160 25.3 W	927	34.50	652.6	40
27	28	91	15 44.3 S	160 25.3 W	2269	34.62	660.8	40
27	28	91	15 44.3 S	160 25.3 W	2701	34.44	649.7	40
27	28	91	15 44.3 S	160 25;3 W	3863	34.67	666.8	40
May 9	May 10	102	16 24.9 N	171 59.3 E	84	34.99	699.8	40
9	10	102	16 24.9 N	171 59.3 E	126	35.08	707.0	40
9	10	102	16 24.9 N	171 59.3 E	170	35.23	721.7	40
9	10	102	16 24.9 N	171 59.3 E	255	34.94	696.9	40
9	10	102	16 24.9 N	171 59.3 E	338	34.33	636.9	40
9	10	102	16 24.9 N	171 59.3 E	423	34.20	624.8	40
9	10	102	16 24.9 N	171 59.3 E	987	34.49	651.0	40
9	10	102	16 24.9 N	171 59.3 E	2655	34.65	665.6	40
15	16	105	18 42.8 N	156 15.8 E	0	34.92	692.8	40
15	16	105	18 42.8 N	156 15.8 E	70	35.04	701.8	40
15	16	105	18 42.8 N	156 15.8 E	93	35.12	710.7	40
15	16	105	18 42.8 N	156 15.8 E	188	35.15	714.2	40
15	16	105	18 42.8 N	156 15.8 E	235	34.90	690.5	40
15	16	105	18 42.8 N	156 15.8 E	437	34.32	634.8	40
15	16	105	18 42.8 N	156 15.8 E	893	34.38	640.6	40
15	16	105	18 42.8 N	156 15.8 E	1693	34.57	660.4	40
27	28	108	18 26.1 N	144 01.2 E	23	34.99	696.9	40
27	28	108	18 26.1 N	144 01.2 E	281	34.79+	679.7	40
27	28	108	18 26.1 N	144 01.2 E	377	34.53	655.1	40
27	28	108	18 26.1 N	144 01.2 E	649	34.25	629.1	40
27	28	108	18 26.1 N	144 01.2 F	1412	34.55	657.8	40
27	28	108	18 26.1 N	144 01.2 E	2335	34.64-	663.9	40
June 3	June 4	111	31 00.1 N	144 16.2 E	71	34.70	668.2	40
3	4	111	31 00.1 N	144 16.2 E	187	34.74	673.6	40
3	4	111	31 00.1 N	144 16.2 E	377	34.44	644.3	40
3	4	111	31 00.1 N	144 16.2 E	471	34.15	617.2	40
3	4	111	31 00.1 N	144 16.2 E	483	34.14	618.0	40
3	4	111	31 00.1 N	144 16.2 E	559	34.08	611.5	40
3	4	111	31 00.1 N	144 16.2 E	565	33.97	601.4	40
July 1	July 2	116	38.40.9 N	147 41.2 E	0	33.99	606.3	30
1	2	116	38 40.9 N	147 41.2 E	22	33.96	603.5	30
1	2	116	38 40.9 N	147 41.2 E	43	33.77	581.7	30
1	2	116	38 40.9 N	147 41.2 E	65	34.03	609.0	30
1	2	116	38 40.9 N	147 41.2 E	444	34.10	613.0	30
1	2	116	38 40.9 N	147 41.2 E	535	34.18	621.4	30
1	2	116	38 40.9 N	147 41.2 E	668	34.24	628.4	30
1	2	116	38 40.9 N	147 41.2 E	781	34.31	633.1	30
7	8	119	45 24.0 N	159 35.7 E	0	32.99	495.8	30
7	8	119	45 24.0 N	159 35.7 E	5	33.01	497.5	30
7	8	119	45 24.0 N	159 35.7 E	22	33.02	501.4	30
7	8	119	45 24.0 N	159 35.7 E	45	33.06	503.7	30
7	8	119	45 24.0 N	159 35.7 E	72	33.14	514.6	30
7	8	119	45 24.0 N	159 35.7 E	90	33.12	512.8	30
7	8	119	45 24.0 N	159 35.7 E	97	33.20	520.7	30
7	8	119	45 24.0 N	159 35.7 E	183	33.77	576.1	30
7	8	119	45 24.0 N	159 35.7 E	230	33.93	592.2	30
7	8	119	45 24.0 N	159 35.7 E	277	34.02	601.9	30
13	14	122	46 16.3 N	174 03.0 E	0	32.81	483.3	30
13	14	122	46 16.3 N	174 03.0 E	22	32.87	487.3	30

Table 1. Titration comparisons used in calibration of salinity bridge--Concluded

Date		Station no.	Latitude	Longitude	Depth	Salinity by titration	Slide-wire reading	Nominal regulating temperature
Bridge	Titration							
1929	1929		° ′	° ′	m			°C
July 13	July 14	122	46 16.3 N	174 03.0 E	45	33.04	505.3	30
13	14	122	46 16.3 N	174 03.0 E	67	33.09	509.6	30
13	14	122	46 16.3 N	174 03.0 E	90	33.12	512.0	30
13	14	122	46 16.3 N	174 03.0 E	135	33.21	519.2	30
13	14	122	46 16.3 N	174 03.0 E	182	33.41	543.5	30
13	14	122	46 16.3 N	174 03.0 E	273	33.79	581.9	30
13	14	122	46 16.3 N	174 03.0 E	365	33.98	602.3	30
13	14	122	46 16.3 N	174 03.0 E	460	34.12	614.0	30
19	20	125	51 57.7 N	150 38.7 W	0	32.75-	474.5	30
19	20	125	51 57.7 N	150 38.7 W	5	32.74+	473.4	30
19	20	125	51 57.7 N	150 38.7 W	24	32.73	471.8	30
19	20	125	51 57.7 N	150 38.7 W	46	32.79	478.6	30
19	20	125	51 57.7 N	150 38.7 W	66	32.84	481.6	30
19	20	125	51 57.7 N	150 38.7 W	175	33.85	583.9	30
25	26	128	40 36.8 N	132 23.3 W	1093	34.41	645.7	30
25	26	128	40 36.8 N	132 23.3 W	1655	34.47	651.2	30
25	26	128	40 36.8 N	132 23.3 W	2180	34.60	658.9	30
Sep. 10	Sep. 11	133	29 20.7 N	132 30.0 W	0	34.71	671.6	30
10	11	133	29 20.7 N	132 30.0 W	23	34.73	680.9	30
10	11	133	29 20.7 N	132 30.0 W	93	34.77	678.2	30
10	11	133	29 20.7 N	132 30.0 W	279	33.96	597.7	30
10	11	133	29 20.7 N	132 30.0 W	373	33.98	607.1	30
10	11	133	29 20.7 N	132 30.0 W	581	34.09	611.9	30
10	11	133	29 20.7 N	132 30.0 W	2739	34.62	665.3	30
10	11	Evaporimeter sample				35.69	760.3	30
10	11	Evaporimeter sample				33.59	565.7	30
10	11	Evaporimeter sample				37.05	891.7	30
16	17	136	26 12.7 N	142 02.5 W	0	35.36	734.5	30
16	17	136	26 12.7 N	142 02.5 W	48	35.13	712.4	30
16	17	136	26 12.7 N	142 02.5 W	95	34.99	701.3	30
16	17	136	26 12.7 N	142 02.5 W	663	34.15	618.7	30
16	17	Evaporimeter sample				38.22	994.6	30
16	17	Evaporimeter sample				35.25	722.1	30
Oct. 9	Oct. 10	143	34 05.9 N	157 08.7 W	0	34.43	641.8	30*
9	10	143	34 05.9 N	157 08.7 W	4	34.42	641.5	30*
9	10	143	34 05.9 N	157 08.7 W	20	34.44	644.0	30*
9	10	143	34 05.9 N	157 08.7 W	40	34.39	643.2	30*
9	10	143	34 05.9 N	157 08.7 W	56	34.19	619.1	30*
9	10	143	34 05.9 N	157 08.7 W	163	34.20	622.7	30*
9	10	143	34.05.9 N	157 08.7 W	506	33.98	602.3	30*
9	10	143	34 05.9 N	157 08.7 W	722	34.09	609.2	30*
9	10	143	34 05.9 N	157 08.7 W	1877	34.59	657.1	30*
15	16	146	31 50.9 N	140 49.6 W	22	34.86	687.9	30
15	16	146	31 50.9 N	140 49.6 W	469	34.01	603.0	30
15	16	146	31 50.9 N	140 49.6 W	665	34.04	611.2	30
15	16	146	31 50.9 N	140 49.6 W	764	34.23	625.8	30
15	16	146	31 50.9 N	140 49.6 W	1096	34.42	646.0	30
15	16	146	31 50.9 N	140 49.6 W	1650	34.53	656.1	30
15	16	146	31 50.9 N	140 49.6 W	2173	34.60	661.9	30
27	28	152	10 04.9 N	139 43.6 W	0	33.67	568.7	40
27	28	152	10 04.9 N	139 43.6 W	24	34.51	651.3	40
27	28	152	10 04.9 N	139 43.6 W	188	34.70	672.3	40
27	28	152	10 04.9 N	139 43.6 W	283	34.68+	670.0	40
27	28	152	10 04.9 N	139 43.6 W	472	34.61	661.0	40
27	28	152	10 04.9 N	139 43.6 W	583	34.56	656.4	40
27	28	152	10 04.9 N	139 43.6 W	870	34.53	654.4	40
27	28	152	10 04.9 N	139 43.6 W	2948	34.67	677.5	40
27	28	152	10 04.9 N	139 43.6 W	3923	34.68-	666.3	40
Nov. 8	Nov. 9	158	6 33.1 S	154 58.4 W	0	35.57	752.3	40
8	9	158	6 33.1 S	154 58.4 W	24	35.57	754.0	40
8	9	158	6 33.1 S	154 58.4 W	73	35.66-	760.9	40
8	9	158	6 33.1 S	154 58.4 W	96	35.85	780.5	40
8	9	158	6 33.1 S	154 58.4 W	193	35.66-	762.8	40
8	9	158	6 33.1 S	154 58.4 W	2260	34.62	660.1	40
15	16	161	12 03.6 S	164 57.4 W	0	35.52	746.1	40
15	16	161	12 03.6 S	164 57.4 W	24	35.62	754.5	40
15	16	161	12 03.6 S	164 57.4 W	48	35.64	758.1	40
15	16	161	12 03.6 S	164 57.4 W	72	35.79	770.4	40
15	16	161	12 03.6 S	164 57.4 W	96	36.04	791.9	40
15	16	161	12 03.6 S	164 57.4 W	146	36.20	808.9	40
15	16	161	12 03.6 S	164 57.4 W	191	35.92	783.1	40
15	16	161	12 03.6 S	164 57.4 W	286	35.14	709.7	40

* Bridge values considered unreliable because of large differences between initial and final standards

the date of measurement to determine whether or not there had been any change in the bridge calibration which might have been caused by differential aging among the end coils and slide wire or by corrosion. As the differences were not systematic with respect to time, no corrections for time were applied.

These differences were then plotted against their respective salinities as given by equation (2). In this case systematic differences were found and a smooth curve drawn through them. The departures of this curve from zero were then tabulated as corrections to be applied to the salinities determined from the slide-wire readings by means of equation (2). These corrections, given in table 2, are largely attributable to irregularities in the slide wire. The alternative assumption is that these differences arise from variation in composition of the salt, and such an assumption would require that the composition be an irregular function of the salinity. Such a relation seems highly improbable. When these corrections are applied to the salinities derived from equation (2), of the 219 comparisons, 212 differ from the titration values by amounts equal to or less than 0.04 per mille salinity. This seens to show an even greater constancy of salt composition than has been assumed in the past and leads one to question the accuracy of chemical analyses of sea water as published in the past. Such published analyses indicate that if solutions of each were adjusted to equal concentration, the salinities as given by titration would differ in some cases in

Table 2. Corrections to be applied to salinities computed from second degree equation

Computed salinity		Correction
From	To	
o/oo	o/oo	o/oo
....	33.03	±0.00
33.04	33.23	0.01
33.24	33.61	0.02
33.62	33.68	0.01
33.69	33.75	±0.00
33.76	33.83	-0.01
33.84	33.96	-0.02
33.97	34.15	-0.03
34.16	34.44	-0.02
34.45	34.55	-0.01
34.56	34.63	±0.00
34.64	34.71	-0.01
34.72	34.85	-0.02
34.86	34.98	-0.01
34.99	35.15	±0.00
35.16	35.27	0.01
35.28	35.68	0.02
35.69	35.77	0.03
35.78	36.08	0.04
36.09	36.15	0.03
36.16	36.20	0.02
36.21	36.24	0.01
36.25	36.28	±0.00
36.29	36.32	-0.01
36.33	36.57	-0.02
36.58	36.90	-0.01
36.91	37.30	±0.00
37.31	37.69	0.01
37.70	38.10	0.02
38.11	....	0.03

the first decimal place of parts per thousand. Obviously no such variations were encountered in the cruise of the Carnegie.

As a routine matter the samples of sea water collected at an oceanographic station in the morning were transferred, on arrival at the surface, to glass bottles of the citrate-of-magnesia type. These bottles were of about 350-cc capacity and were equipped with patent rubber washer stoppers. The same glass bottles were used repeatedly and were used only for sea water. The rubber washers were replaced as often as their deterioration required. To guard further against evaporation, dilution, or contamination of the samples, their salinities were measured on the afternoon of the same day they were collected.

The covers were removed from the salinity bridge and the stirring motor and thermostatically controlled heaters of the water bath were set in operation about an hour before measurements were started, in order to have equilibrium conditions of temperature established. The salinity bridge had three measuring cells, any one of which could be switched into the bridge circuit. The auxiliary cell had in series with it a small adjustable wire-wound resistance which will be called Q for convenience. The first step was to exhaust the measuring cells of the water which had been standing in them and to fill them with standard water after rinsing them with some of the same standard water. The sealed glass tubes of Copenhagen standard water were opened only as needed and their contents transferred to a glass-stoppered stock bottle. Any standard water remaining in the stock bottle from a previous run was used only for rinsing, the cells being filled with water from newly opened tubes. The time of filling each cell was then recorded. Fifteen minutes after the first cell was filled with standard water, the slide wire was set at a reading corresponding to the salinity of the standard water and the bridge balanced by adjusting Q. This adjustment was then tested by moving the slide wire and rebalancing the bridge by adjusting the slide wire. The setting of Q was correct if the slide wire was brought back to its original setting to balance the bridge. This reading of Q was then recorded for this particular cell, the standard water was removed from the cell which was then rinsed and filled with water from one of the samples to be measured. Record was made of the time of filling and the identity of the sample which took its designation from the number on the glass bottle in which it had been stored. Then the adjustment of Q was determined for the second cell, which in turn was filled with water to be tested. A similar procedure was followed for the third cell. Fifteen minutes after the unknown was placed in the first cell, Q was set to the reading previously obtained for that cell, the cell was switched into the circuit, and the bridge balanced by the adjustment of the slide wire. This slide-wire reading was recorded and the sample withdrawn from the cell, which was then rinsed and filled with water from another sample. The time of filling was again recorded and similar operations performed with the other cells until all the samples had been measured. As the last sample in each cell was removed, it was replaced by standard water. This standard water was measured exactly as if it were an unknown sample. The difference between the slide-wire reading for this final standard and its correct value (that for the initial standard) represented changes in the cells, changes in the solution in the auxiliary cell, or errors in the measurement of

either the initial or final standards. In the absence of any evidence to the contrary, it was assumed that this difference was the result of a gradual change and the difference was therefore proportioned according to the number of samples measured in the cell. After this shearing correction was applied to the slide-wire readings, they were converted to salinities by means of the previously discussed equation and corrections. The final standards were allowed to remain in the measuring cells until the bridge was used again. A specimen set of observations and computations is shown in table 3.

The design feature of having similar electrolytic cells form two adjacent arms of the bridge has, as one of its objectives, lessening the importance of accurate temperature control. In other words, it was hoped that by this device the effective temperature coefficient of the instrument would be much less than that of sea water. The efficacy of this arrangement was tested on the Carnegie as follows: When the regulating temperature of the water bath was changed from 30° to 40° C., Copenhagen standard water, which was used as the final standard at the end of the last 30° C routine salinity run, was left in the cells and was remeasured on the following day at 40° C, with the auxiliary resistance Q having the same setting as was used at 30° C. The differences in slide-wire readings were converted into differences in salinity and considered to be the effect produced by a 10° C change in temperature of a sample. This was done on a basis of 1.0 unit on the slide wire corresponding to a change of 0.01 per mille in salinity. This procedure further was based on the assumptions that during the period of about 24 hours the salinity of the solution in the auxiliary or Y cell did not change and that the cell constants did not change. Such assumptions were justifiable as only a rough determination was made. The slide-wire reading at the balance of the initial standard was 698.5 in each case, by definition. Either because of changes in cell constants or changes in the auxiliary cell

Table 3. Specimen set of observations and computations of salinity

Sample no.	Time	Q	Observed S. W. reading	Shearing correction	Corrected S. W. reading	Salinity from equation	Correction	Final salinity, ‰	Depth in meters
				Cell A					
....[a]	1:56	1.124	698.5	....	....	....	....	....	......
227	2:14	1.124	645.7	+ 0.1	645.8	34.45	-0.01	34.44	933
226[b]	2:36	1.125	628.8	+ 0.3	629.1	34.28	-0.02	34.26	649
104	2:55	1.124	664.5	+ 0.4	664.9	34.65	-0.01	34.64	3189
121[c]	3:14	1.124	696.3	+ 0.6	696.9	34.97	-0.01	34.96	23
105	3:32	1.124	697.6	+ 0.7	698.3	34.99	±0.00	34.99	94
119[d]	3:51	1.124	654.2	+ 0.9	655.1	34.54	-0.01	34.53	377
....[a]	4:08	1.124	697.5	....	....	....	....	....	......
			698.5						
			7|1.0						
			+0.1 3/7						
				Cell B					
....[a]	1:58	2.016	698.5	....	....	....	....	....	......
114	2:20	2.016	660.5	- 0.1	660.4	34.60	±0.00	34.60	1888
123[e]	2:38	2.016	658.0	- 0.2	657.8	34.57	±0.00	34.57	1412
101	2:59	2.016	699.8	- 0.3	699.5	35.00	±0.00	35.00	0
134	3:17	2.016	698.0	- 0.4	697.6	34.98	-0.01	34.97	46
111	3:36	2.016	702.7	- 0.5	702.2	35.03	±0.00	35.03	187
113	3:54	2.016	635.9	- 0.6	635.3	34.34	-0.02	34.32	473
....[a]	4:14	2.016	699.2	....	....	....	....	....	......
			698.5						
			7|0.7						
			-0.1						
				Cell C					
....[a]	2:04	2.940	698.5	....	....	......	....	....	......
335	2:26	2.940	680.0	-15.8	664.2	34.64	-0.01	34.63	2765
401[f]	2:41	2.940	697.7	-15.8	663.9	34.63	±0.00	34.63	2335
274	3:02	2.940	711.3	-15.8	695.5	34.96	-0.01	34.95	5
115	3:20	2.940	718.5	-15.8	702.7	35.03	±0.00	35.03	70
347[g]	3:39	2.940	695.5	-15.8	679.7	34.80	-0.02	34.78	281
110	3:56	2.940	645.4	-15.8	629.6	34.29	-0.02	34.27	666
....[a]	4:18	2.940	714.3	-15.8	....	....	....	....	......
			698.5[h]						
			-15.8						

[a] Copenhagen standard water. [b] 34.25 per mille by titration by J. H. P., May 28, 1929. [c] 34.99 per mille by titration by J. H. P., May 28, 1929. [d] 34.53 per mille by titration by J. H. P., May 28, 1929. [e] 34.55 per mille by titration by J. H. P., May 28, 1929. [f] 34.64 per mille by titration by J. H. P., May 28, 1929. [g] 34.79 per mille by titration by J. H. P., May 28, 1929. [h] Initial standard discarded as being probably in error.

solutions, the slide-wire readings were slightly different for the final standard than for the initial standard. If it is assumed that these changes were permanent, the slide-wire readings for the final standard should be used whereas if these changes are assumed to have been temporary and to have disappeared (such as might be the case if part of the auxiliary cell solution vaporized during the run and condensed again afterward), then the slide-wire readings of the final standard should be used. Following the remeasurement of the final standards at 40°C, they were withdrawn and replaced by other samples originally having the same salinity, and another series of slide-wire readings taken. Assuming that no change in salinity of the final standards had occured, the final standard as remeasured should be used. If it be assumed that the final standard had changed in salinity, then the fresh standard should be used. Thus there are four combinations per cell which will give a temperature coefficient of salinity. Their means have been taken as shown in table 4.

These temperature coefficients, even if accurately determined, would only apply with the same settings of the auxiliary resistance Q. As the settings given above approximately represent ohms and as the resistance of the cells were about 250 to 300 ohms each, it is seen that the uncompensated sea-water resistance was about 1 per cent of the resistance of the unknown. Taking the temperature coefficient of electrical conductivity of sea water as 3 per cent per degree centigrade, the temperature coefficient of salinity of the bridge would have been expected to be of the order of 0.0003×35.00 or about 0.01 per mille per degree centigrade. The general agreement between the experimental and calculated values indicates that the temperature coefficient of the bridge arm containing the Y cell differed from that of the arm containing the X cell by not more than 3 parts in 10,000. This would not be true generally, but would depend on the difference in cell constants of the X and Y cells and on the ratio of the resistance of Q to the resistance of the sea water in the Y cell. It may be noted, however, that had a wire resistance been used in place of sea water in the Y cell, the temperature coefficient would have been in the neighborhood of 0.03×35 or about 1 per mille per degree centigrade. It should be understood that the wire resistances in the bridge were of manganin, having a negligible temperature coefficient, and that when measurements were made the X and Y cells were accurately at the same temperature.

Copenhagen standard water was used at every third station, substandards being used at the intermediate stations. At a station where Copenhagen water was used, three large samples were taken, measured, and the surplus kept until the next station (usually two days later), when they were used as standards in the same manner as the Copenhagen water was used. At this second station large samples were again measured for use as standards at the third station. At the next succeeding station, Copenhagen water was again used and the cycle repeated. It will be seen then that the possible errors of a single determination of salinity at successive stations are 1, 2, and 3 times the error of a single determination made at a station where Copenhagen standard water was used. The bridge could be balanced to about 0.002 per mille salinity but the accuracy of the measurement was not as great as this precision because of the uncertainty of the resistance Q, errors in the assumption that a shearing correction compensated for the difference between initial and final standards, and other minor factors such as unequal heating caused by the test current. Individual measurements were therefore accurate to within about 0.02 per mille salinity in terms of that of the standard used. Thus, if the salinity of the Copenhagen standard water was accurately known, measurements against such a standard were good to about 0.02 per mille salinity. Consequently it is possible that at stations where a first substandard was used the measurements might have been in error by 0.04 per mille and at stations where a second substandard was used an error of 0.06 per mille was possible. This is highly improbable, however, inasmuch as such a situation would require all the errors to be made in the same direction and, as three different cells were used for the measurement of samples from each station, such discrepancies would probably have been detected in plotting vertical distribution curves, unless the standards for all three cells were in error by similar amounts and in the same

Table 4. Data for temperature coefficients of salinity for cells A, B, and C

Cell	Observation	Temperature	Standard	Q	Slide-wire reading	Temperature coefficient	
						From	Value
		°C			d		‰ per °C
A	I	30	Initial	1.913	698.5	I and III	0.0078
	II	30	Final	1.913	698.1	I and IV	0.0047
	III	40	Final	1.913	706.3	II and III	0.0082
	IV	40	New	1.913	703.2	II and IV	0.0051
Mean for cell A	...	...	....	....	....	....	0.0064
B	I	30	Initial	3.048	698.5	I and III	0.0041
	II	30	Final	3.048	698.2	I and IV	0.0067
	III	40	Final	3.048	702.6	II and III	0.0044
	IV	40	New	3.048	705.2	II and IV	0.0070
Mean for cell B	...	...	....	....	....	....	0.0056
C	I	30	Initial	3.208	698.5	I and III	0.0138
	II	30	Final	3.208	698.7	I and IV	0.0116
	III	40	Final	3.208	712.3	II and III	0.0136
	IV	40	New	3.208	710.1	II and IV	0.0114
Mean for cell C	...	...	....	....	....	....	0.0126

direction for each station. The best criterion of the errors involved in these measurements is the scatter of measured values of salinity of the deep water of the Pacific. A composite graph showing such salinity values from a number of stations when plotted against depth is given in figure 2. All measured values from stations 130 to 149 inclusive and from depths below 1800 meters are shown in this figure. The figures opposite the points give the number of the oceanographic station at which the sample was collected and those which are underlined represent stations at which Copenhagen standard water was used. It will be noticed that below 2000 meters only two points depart from the smooth curve by as much as 0.04 per mille. This particular group of stations has been selected as an illustration because it is one of the largest groups in which the deep water has similar characteristics. Other groups show equally good agreement between stations within a group. From these considerations it is concluded that the salinities determined on the Carnegie are reliable to about 0.04 per mille. The results of the salinity work are given in the table giving the data obtained at the series stations (table 2, I-B), and the vertical distribution curves are shown in the graphs preceding the tables.

LITERATURE CITED

Wenner, F., E. H. Smith, and F. M. Soule. 1930. Apparatus for the determination aboard ship of the salinity of sea water by the electrical-conductivity method. Dept. Comm. Bur. Stand. Res., vol. 5, pp. 711-733. September. Washington.

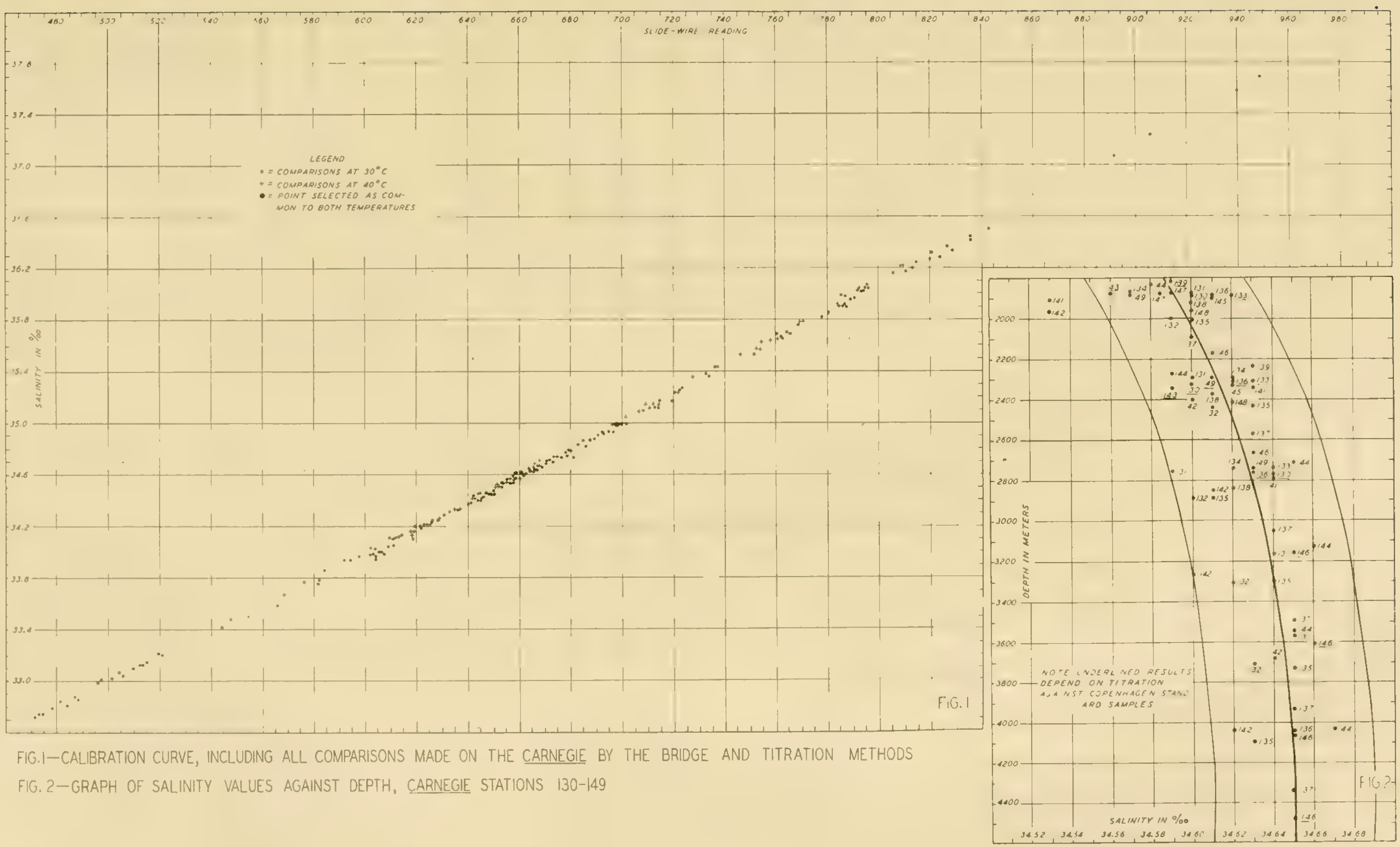


FIG. I—CALIBRATION CURVE, INCLUDING ALL COMPARISONS MADE ON THE CARNEGIE BY THE BRIDGE AND TITRATION METHODS

FIG. 2—GRAPH OF SALINITY VALUES AGAINST DEPTH, CARNEGIE STATIONS 130-149

ON THE ACCURACY OF THE SALINITY VALUES

In the preceding chapter Soule has shown that the readings of the salinity bridge were converted into terms of salinity by means of a calibration curve which was obtained by measuring samples in the bridge and titrating the same samples by the ordinary silver-nitrate method. Owing to this procedure the salinities obtained from bridge readings should, on an average, be equal to salinities determined by titration, but the accidental errors of the values would be somewhat greater, amounting to ±0.04 per mille, mainly since minor deviation from a constant temperature exercised a considerable influence on the bridge readings. A comparison between the Carnegie salinities and those from other expeditions indicates, however, that the Carnegie salinities are, on an average, somewhat too low. This result is arrived at by a study of the conditions at great depths where the salinity is very uniform and where no variations from year to year have been detected.

In his discussion of the deep water of the North Atlantic Wüst (1935) writes (in translation): "In our salinity charts at 1500 to 4500 meters the Carnegie salinities in the open North Atlantic Ocean appear to be on an average 0.03 to 0.04 per mille too low, as also shown from a comparison between the TS-curves at the Carnegie stations and neighboring stations from other expeditions (in single cases the deviations of the Carnegie salinities vary between -0.10 and 0.02 per mille."

In the Pacific Ocean the salinity of the deep water has been determined on two later expeditions, the Dana expedition in 1928 to 1930, and the Bushnell in 1934. The Dana observations have not been communicated in detail, but some of them have been used in special publications. In Schott's (1935) "Geographie des Indischen und Stillen Ozeans," salinities and temperatures are given at the depth of 3000 meters at a station in latitude 20° south and longitude 174° east, and at depths of 3000, 4000, and 5110 meters at a station in latitude 19° south and longitude 163° west. These values can be compared with Carnegie observations at depths greater than 3000 meters at stations 87 to 91 which are located between latitudes 15° and 18° south and longitudes 145° and 160° west. We find:

Stations	Latitude, °S	Longitude °W	Mean depth m	Mean temp. °C	Mean salinity °/oo	No. observations
Dana	19-20	163-186	3775	1.558	34.680	4
Carnegie	15-18	145-160	3357	1.599	34.653	7

The U.S.S. Bushnell undertook oceanographic work in the North Pacific, occupying eighteen stations between Adak, Aleutian Islands and Oahu, Hawaiian Islands, to depths of 2500 to 3500 meters. The observations[1] below 3000 meters can be compared with the Carnegie observations below 3000 meters at stations 122, 142, 144, and 146, of which station 122 is located near the Aleutian Islands and stations 142, 144, and 146 nearer the Hawaiian Islands. We obtain the following table.

Stations	Latitude °N	Longitude °W	Mean depth m	Mean temp. °C	Mean salinity °/oo	No. observations
Bushnell	50-22	158-170	3396	1.501	34.675	13
Carnegie	46-32	140-174	3637	1.528	34.644	11

If we consider 34.67 as the characteristic salinity of this region we find that the single Carnegie salinities deviate from -0.07 to 0.00 per mille from this value. Thus, the range of variation is less than in the North Atlantic, indicating that the accuracy of single determinations was greater during the latter part of the cruise than during the first part.

Compiling these different comparisons we obtain the following differences between the salinity of the deep water as determined on other expeditions and on the cruise of the Carnegie:

North Atlantic	South Pacific	North Pacific
0.03 to 0.04	0.027	0.031

From the systematic character of these differences we must conclude that the Carnegie values of the salinity of the deep water are about 0.03 per mille too low. It follows that all salinity values between 34.6 and 35.0 per mille are too low by the same amount, but it has not been possible to find the cause of this systematic discrepancy, nor has it been possible to decide whether or not a similar discrepancy is present at other values of the salinity.

All tables and graphs had been prepared in final form before this systematic discrepancy was discovered, for which reason the original Carnegie values have not been changed, but in the text attention has been drawn to the discrepancy in all cases in which the exact value of the salinity of the deep water has been discussed.

It may be added that the discrepancy will not influence the results of the dynamic computations, if it has the character of a constant difference, but if the difference depends on the absolute value of the salinity, an error is introduced in the results of such computations. This error will not be serious since it will only influence the data from the upper layers and will no doubt be smaller than uncertainties arising from lack of knowledge as to periodic or aperiodic variations in these layers.

[1] These were kindly placed at the author's disposal by the Scripps Institution of Oceanography.

LITERATURE CITED

Schott, G 1935. Geographie des Indischen und Stillen Ozeans. p. 203. Hamburg.

Wüst, G. 1935. Wissensch. Ergebn. d. Deut. Atlantischen Exped. Meteor 1925-27, vol. 6, no. 1, p. 230, footnote.

The bottom samples were collected with samplers attached to the end of a hemp lead line which in turn was attached to the end of a steel piano wire carried on one of the winch drums and led over a meter-wheel at the stern of the vessel. The striking of bottom by the sampler was determined manually by keeping tension in the outgoing piano wire with a roller bar.

Most of the samples were taken with a snapper-type sampler--the sample being caught in a spring-actuated clamshell. The snapper-type samplers used varied considerably in size, type of trigger, and design of weight, but after considerable experimentation, the type selected as most suitable to the equipment and conditions existing on the Carnegie was that shown in figure 1. Here the pear-shaped lead weight was counterbored to fit down over the spring, thus lowering the center of gravity. Later the lead weight was so arranged as to be left on bottom in order to reduce the strain on the wire when hauling in. This was done as follows. The weights were cast in halves containing staples in their upper ends. When placed on the shank of the snapper they were tacked together by a flat copper staple on each side near the bottom of the weight. A wire whose ends were made fast to the upper staples passed over the hook of a Sigsbee releasing device and held the upper ends of the weight together. When the sampler struck bottom, the Sigsbee device released the wire, the upper ends of the weights fell apart tearing loose the lower staples and the two halves fell clear of the snapper and were left on the bottom.

This type of snapper was of sufficient size to yield about one and one-quarter liters of sample when the bottom was of ooze, mud, or clay. On striking hard bottom it usually collected only a few fragments and the jaws were badly dented and had to be repaired. Nodules, cinders, fragments of obsidian, and similar hard obstructions were sometimes caught between the jaws, thus permitting the rest of the sample to be washed out on the way to the surface.

A tube sampler intended to give a core sample and used on the Meteor was used a few times. It is shown in figure 2. This sampler was lined with a removable glass tube so that the sample could be inspected and stored while still in the lining tube. This type of sampler was not used more frequently because of its considerably greater weight and the pull required to withdraw it from the bottom put too heavy a strain on the piano wire.

The core samples obtained were stoppered in their lining tubes and the samples obtained with snappers were transferred to glass bottles and stoppered soon after collection. They were then shipped to Washington from the next port into which the Carnegie went.

FIG. 1—SNAPPER-TYPE BOTTOM SAMPLER WITH COUNTERBORED LEAD WEIGHT

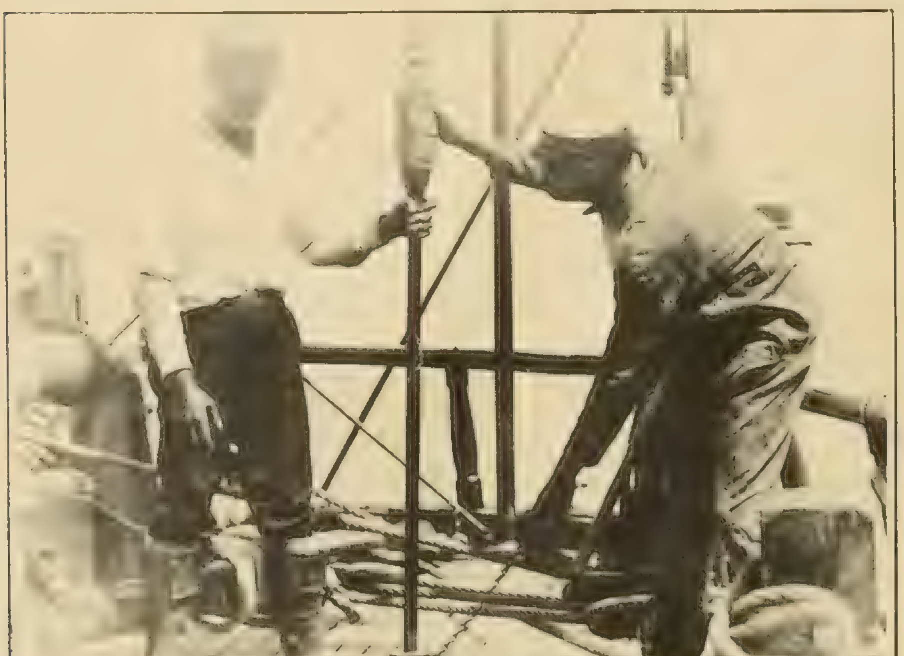


FIG. 2—METEOR TUBE BOTTOM SAMPLER

OBSERVATIONS AND RESULTS IN PHYSICAL OCEANOGRAPHY

II

RESULTS IN PHYSICAL OCEANOGRAPHY

CONTENTS

RESULTS WITHIN PHYSICAL OCEANOGRAPHY

INTRODUCTION

The present paper was prepared in 1930 to 1931, and revised in 1936. In the years 1930 to 1936 a considerable amount of new data was accumulated from the Pacific Ocean. This has not been incorporated in the present discussion, since such procedure would have altered the entire plan of the publication. The only chapter which has been rewritten to some extent is the one dealing with the origin of the deep water of the Pacific, because recent information as to the circulation around the Antarctic Continent has thrown considerably more light on this question and has made more definite conclusions possible.

The writer takes great pleasure in acknowledging the assistance which he has received from members of the staff of the Department of Terrestrial Magnetism, especially from C. C. Ennis, who undertook a great number of the computations, prepared all figures, and in the course of this work made a number of valuable suggestions.

It will be readily realized that the careful reduction of the extensive observations made during the cruise is of paramount importance in any discussion of the results within physical oceanography. The original computations, compilations, and graphs of this observed material were completed under the general direction of J. A. Fleming by Martha W. Ennis, C. C. Ennis, W. C. Hendrix, and S. L. Seaton, Jr. It will be realized that in the course of this work they all made valuable suggestions which have been incorporated and made use of in the present discussion. It will be noted that the general results of the discussion are represented in figures 1 to 38 which follow the text. The graphs of observational material above referred to are independently numbered as figures 1 to 254 and are reproduced in Oceanography I-B. In the text the graphs are referred to as, for example, (fig. 1, I-B).

THE NORTH ATLANTIC OCEAN

Temperature, Salinity, and Density

The physical oceanography of the North Atlantic Ocean has been treated by several authors (Jacobsen, 1929; Helland-Hansen, 1930; Helland-Hansen and Nansen, 1926; and Wüst, 1928) on the basis of modern observations. In the following discussion it will be shown that the results of the Carnegie observations on the whole are in agreement with the previous conceptions as to the physical properties of the waters of the North Atlantic and as to the character of the circulation. Details will be given in only a few cases in which the Carnegie observations throw more light on the problems.

Temperature and Salinity, Stations 1 to 12.--The distances between stations 1 to 12 are so great that the results cannot be used for construction of sections; therefore, the data from the single stations will be discussed separately. Station 1 was in the region of the warm water of the Gulf Stream. The vertical distribution of salinity and temperature was very much like the distribution at station 16, which is located in nearly the same latitude but 21° farther east. Even the vertical changes of pH and PO_4 were similar at the two stations.

Station 2 reached to 400 meters only, and down to this depth there existed a striking similarity to station 15, which was taken in nearly the same locality three months later. It should be noted that the distance to station 16 from station 15 is not much greater but at this station the conditions in the upper 400 meters deviated considerably from those at station 2.

The distances between stations 3, 4, and 5 are small, nevertheless the vertical distribution of temperature and salinity at these stations differed considerably. Station 4 reached to 300 meters only, and down to that depth showed lower temperatures and lower salinities than the two neighboring stations. The difference between stations 3 and 5 was especially great at the depths between 500 and 1500 meters, where the temperature and salinity were higher at station 5 than at station 3. The differences in the density, σ_t, therefore, had a maximum at about 700 meters, as shown in table 1.

Station 6, which is located to the southwest of Ireland, showed still higher temperatures and salinities at depths 1000 and 1500 meters. The temperature and salinity at 1000 meters, 8°50 and 35.52 per mille, respectively, appear very high, but the Michael Sars, station 93, (Helland-Hansen, 1930) gave 8°27 and 35.47 per mille on July 25, 1910 in nearly the same locality.

Stations 7 and 8 are located to the east-southeast of Iceland; the former on the Iceland-Faroe Ridge, the latter on the shelf surrounding Iceland. At the latter station water of Atlantic character--high temperature and high salinity--was found to a depth of more than 700 meters, whereas at the former the Atlantic water reached from the surface down to 200 meters, but the characteristic water of the Norwegian Sea was met with at the bottom, 454 meters.

Table 1. Comparison of values of density, σ_t, at Carnegie stations 3 and 5, 1928

Depth in meters	Density, σ_t		Difference (3 - 5)
	Station 3	Station 5	
0	26.69	26.66	+0.03
100	26.96	26.98	-0.02
200	27.03	27.04	-0.01
300	27.05	27.06	-0.01
400	27.11	27.08	+0.03
500	27.20	27.10	+0.10
700	27.41	27.18	+0.23
1000	27.67	27.58	+0.09
1500	27.78	27.77	+0.01
2000	27.81	27.78	+0.03

At station 9, to the southwest of Iceland, water of a relatively high temperature and salinity was still found, but at stations 10 and 11 low temperatures were present below a depth of 75 or 100 meters, and salinities above 35 per mille occurred only at some levels above 200 meters.

At station 12 the temperature was still lower, namely 3.°60 at 75 meters, decreasing to 3.°30 at 500, 3.°10 at 1000, and 2.°75 at 2000 meters, whereas the salinity remained practically constant and equal to 34.87 per mille, perhaps increasing slowly with depth below 500 meters. The density in situ was almost constant between 75 and 100 meters, varying between 27.74 and 27.77, but below 700 meters it increased slowly to 27.86 at 2500 meters.

The uniform character of the water in the region of station 12 has been pointed out by Matthews and considered by Jacobsen (1929), who especially discussed the opinion of Nansen regarding the origin of the deep water of the Western Atlantic Basin. Nansen had indicated that the region southeast of Greenland is a place where this deep water is formed, because cooling of the surface layers in winter may give rise to convective currents, which, because of the uniform character of the water, may reach to great depths. Jacobsen, however, arrives at the result that these processes probably contribute to the formation of the uniform water north of the Grand Banks of Newfoundland, whereas the true bottom water comes from the continental shelf in Denmark Strait.

Vertical Sections

The most important results of the work of the Carnegie in the Atlantic are represented in the two vertical sections I and II. Section I is based on the observations at stations 13 to 24 and shows a north and south section approximately along the meridian 40° west between latitudes 46° and 8° north. Section II is from the observations at stations 25 to 34 and shows an east and west section approximately along the parallel 12° north and between longitudes 37° and 79° west.

Section I.--Section I, comprising stations 13 to 24, is taken across the Atlantic Ridge, as is evident from the profile of the bottom. Station 13 is situated on the Grand Banks of Newfoundland; stations 14, 15, and 16 in the Western Atlantic Basin; stations 17 and 18 on the ridge; and the rest of the stations, from 19 to 24, are in the Eastern Basin.

The isotherms in Section I (fig. 94; I-B) show the well-known accumulation of warm water with its center at about latitude 30° north. Considering the rapid variation in temperature with the distance from the Grand Banks, a station on the slope of the Grand Banks would have been of value in order to establish the course of the isotherms. The double bend of the isotherms south of the Grand Banks indicates the existence of a whirl at the boundary between the cold water on the southern slope of the Grand Banks and the warmer water to the south. In this region, but in another location, a similar whirl is indicated by the Michael Sars section (Helland-Hansen, 1930), which runs a little to the west of the Carnegie section. It is probable that changing whirls of different dimensions are formed at the boundary of the Gulf Stream, for which reason the hydrographic conditions in a given locality may change rapidly. Our section, therefore, represents the conditions as observed by the Carnegie, but probably not any stationary conditions.

The isohalines in Section I (fig. 95; I-B) clearly show the great accumulation of water of high salinity with its center at about latitude 30° north. The isohaline 35 per mille reaches, at the center, to a depth of more than 2000 meters. The whirl to the south of the Grand Banks, which was indicated by the temperature distribution, is also shown by the course of the isohalines.

To the south the influence of the intermediate Antarctic Current is seen in the minimum of salinity at a depth between 500 and 1000 meters. The effect of this intermediate current reaches, according to the Carnegie, at least beyond station 20 or to about latitude 20° north, and perhaps can be traced as far as between stations 18 and 19, or about latitude 26° north.

At the surface the greatest salinity is found between stations 18 and 19, or between latitudes 24° and 30° north. From the course of the isohalines, it seems that water of very great salinity is spreading to the north and to the south at a level of about 100 meters. This water represents the type which Jacobsen (1929) has called "central water" in his discussion of the results of the Dana expedition 1920 to 1922. Jacobsen shows, in agreement with the Carnegie results, that at a level of about 100 meters this water is flowing away from the region in which it is being formed, the Sargasso Sea region.

The deep water appears to have a salinity slightly below 34.90 per mille in both the Western and Eastern basins, but the Carnegie values are probably 0.03 to 0.04 per mille too low.

The density curves in Section I (fig. 96; I-B) show especially that the difference in density between stations 15 and 16 reaches a maximum somewhere below the surface. When discussing the conditions at stations 3 and 5 (p. 30 and table 1), it was pointed out that the greatest difference in density was found at a depth of about 700 meters. Table 2 is the result of an examination of stations 15 and 16. Here we find a considerable difference in the upper layers, reversal of sign, and a new maximum at about 500 and 700 meters.

Table 2. Comparison of values of density, σ_t, at Carnegie stations 15 and 16, 1928

Depth in meters	Density, σ_t		Difference (15 - 16)
	Station 15	Station 16	
0	24.47	23.95	+0.52
100	26.28	25.94	+0.32
200	26.41	26.41	0
300	26.42	26.61	-0.19
400	26.44	26.80	-0.36
500	26.49	26.93	-0.44
700	26.77	27.25	-0.48
1000	27.30	27.58	-0.28
1500	27.73	27.77	-0.04
2000	27.79	27.80	-0.01

Section II.--Section II, stations 25 to 34, runs approximately east and west, following the parallel of about 12° north from 37° to 79° west longitude. It begins in the Eastern Basin of the Atlantic in which stations 25 and 26 are located, and continues across the ridge (with station 27 on the ridge), into the Western Basin in which stations 28, 29, and 30 are situated. It then crosses the threshold of the Caribbenn Sea, in which the last four stations--31, 32, 33, and 34--are located.

At the surface the temperature (fig. 210; I-B) is uniform and high--between 25° and 30° C. In the Caribbean Sea we find in the upper layers a greater accumulation of warm water than in the Atlantic, the isotherms of 10° and 15° being found at greater depths in the Caribbean. The observations below a depth of 1000 meters in the Caribbean Sea indicate that below this depth the temperature remains almost constant. At all stations it decreases slightly with increasing depth, but the decrease is so slow that the deepest observation gives a temperature of 4.°07 at a depth of 2287 meters, against 3.°20 at the same depth outside the Caribbean Sea (station 30). The observations of the Dana in the Caribbean Sea (Jacobsen, 1929) give, on an average, a similar result, as is evident from table 3.

Table 3. Temperature below 1000 meters in the Caribbean Sea according to the Dana and the Carnegie

Source	Depth in meters		
	1000	1500	2000
	°	°	°
Dana (8 stations)	4.98	4.22	4.09
Carnegie (4 stations)	4.91	4.15	4.08

The observations at great depths by the Dana indicate a rise of the temperature from a level of 2000 or 2500 meters toward the bottom, corresponding approximately to adiabatic equilibrium.

In the Atlantic part of Section II the temperature decreases regularly toward the bottom, the lowest value observed being 2.°17 at a depth of 4703 meters at station 30.

The salinity curves in Section II (fig. 101; I-B) show a maximum below the surface at a depth of about 100 meters. This maximum, as already pointed out by Jacobsen, is probably related to the existence of currents which carry salt water from the central part of the Atlantic Ocean to the south.

The salinity minimum at a level of about 700 meters, indicating the intermediate Antarctic Current, is clearly seen. It also is evident that this intermediate water penetrates the Caribbean Sea, but here it probably becomes mixed with the overlying and underlying water since the salinity of the intermediate water increases somewhat when proceeding to the west. These features have been treated thoroughly by Jacobsen, who especially has examined the mixing of the water masses of different origin.

The Carnegie observations indicate a decrease in the salinity of the water of the Caribbean Sea below a depth of 1000 meters, but this decrease is probably not a real feature in spite of the fact that it is shown by the observations at two stations, 33 and 34. At the former a salinity of 34.76 per mille was observed at a depth of 2075 meters, and at the latter a salinity of 34.74 per mille at 2287 meters. The observations of the Dana below a level of 1200 meters, however, show a uniform salinity varying between 34.95 per mille and 34.98 per mille. The observed values at the greatest depths of stations 33 and 34 therefore have been rejected and, instead, it was assumed that the salinity at a level of 2000 meters was 34.96 per mille at both stations. When carrying out the dynamic calculation this value was used.

The Deep Water of the Atlantic

Temperature.--Helland-Hansen (1930) has shown that the Challenger observations indicate that the bottom temperatures decrease with increasing depth in the Western Atlantic Deep, but increase in the Eastern Atlantic Deep. Introducing the potential temperature, θ, defined as the temperature which a water particle attains when it is raised adiabatically to the surface of the sea, he found that the potential temperature decreases with increasing depth in the Western Deep but remains constant in the Eastern Deep. The absolute values are lower in the Western Deep and this result is confirmed by the observations of the Dana.

We have table 4 as a result of an examination of the potential temperature of the water below a depth of 4000 meters according to the Carnegie observations. The data are too few to permit any conclusions as to the average conditions in the two basins, except that the potential temperature is lower in the Western Deep than in the the Eastern. It may be added that all values in the Eastern Deep are lower than the average value, 2.°15, found by Helland-Hansen from the Challenger observations.

Salinity.--Table 5 is the result of the observations of salinity below a level of 4000 meters. The salinity appears to be slightly lower in the Eastern Deep, but the values are too few and show too much scattering to permit any definite conclusions. The absolute values are, as stated on page 72, probably 0.03 to 0.04 per mille too low.

Table 4. Values of potential temperature, Atlantic deep water, Carnegie, 1928

Western deep			Eastern deep		
Station	Depth	θ	Station	Depth	θ
	m	°		m	°
14	4061	1.86	19	4091	2.10
				4616	2.03
				5148	1.96
15	4319	2.01			
	4841	1.90			
			21	4126	2.07
			23	4076	2.06
30	4703	1.73			
Mean	4481	1.88		4411	2.04

Table 5. Values of salinity, Atlantic deep water, Carnegie, 1928

Western deep			Eastern deep		
Station	Depth	S,	Station	Depth	S,
	m	‰		m	‰
14	4061	34.89	19	4091	34.87
				4616	34.80
				5148	34.83
15	4319	34.89			
	4841	34.85			
			21	4126	34.87
			23	4076	34.81
Mean	4407	34.88		4411	34.84

For comparison we add table 6 which shows the mean potential temperature and the salinity at an approximate depth of 4500 meters according to the observations of Challenger, Dana, and Carnegie.

Table 6. Mean potential temperature and salinity, Atlantic deep water, Carnegie, 1928

Source	Western deep		Eastern deep	
	θ	S	θ	S
	°	°/oo	°	°/oo
Challenger	2.00		2.15	
Dana	1.91 (16)	34.89 (17)	2.08 (9)	34.90 (9)
Carnegie	1.88 (4)	34.88 (3)	2.04 (5)	34.84 (5)

The number of observations are shown in parenthesis

The temperatures of the Challenger appear to be about 0°.1 too high. The Dana and Carnegie temperatures agree well, but the Dana salinities are 0.035 per mille higher on an average.

Temperature-Salinity Relation

The temperature-salinity (tS) diagrams, which were introduced by Helland-Hansen (1918), have proved very helpful in the discussion of the origin and the mixing of the different types of water in the oceans. The tS diagrams therefore have been plotted for each station.

Jacobsen (1929) has discussed the character of the waters of the North Atlantic by means of the tS diagrams from the Dana expeditions. A comparison shows that the data from the Carnegie are, on the whole, in good agreement with the data which Jacobsen discusses. A similar discussion therefore would not lead to any new conclusions. We have seen (pp.30,31) that we found rather different conditions at the neighboring stations 3, 5, 15, and 16, and it is of interest to examine the extent to which water of a similar character is met with at these stations.

In figure 1 the tS curves for these four stations have been plotted. It is seen that they all agree quite well and that no considerable deviations from an average normal tS relation occur. Below a depth of 700 meters, however, where the discrepancies between the stations are found, we find agreement between the conditions at stations 3 and 16, and from 1000 and 1500 meters we find agreement at stations 5 and 15. Therefore, it can hardly be doubted that the water of high salinity and high temperature which is found between 700 and 1500 meters at station 5 comes from the west. On the other hand, it is not very probable that we can trace a continuous flow of this water from the region of station 15 to the region of station 5, because station 3 falls between the two localities. It is more probable that in both localities we deal with whirls which develop at the boundary of the strong Atlantic Current.

For comparison the tS diagram for station 6 has been shown in the same figure. This curve has a widely different course and at the depth of 1000 meters the deviation from the normal tS relation is very great. According to Helland-Hansen and Nansen this deviation in the region of station 6 must be ascribed to the influence of the Mediterranean water. When discussing the data from this station, it was pointed out that the high temperatures and salinities are, as a rule, found between 700 and 1500 meters in the region where the station was occupied.

We shall not enter any more into detail as to the tS relations, but shall draw attention to some major features. When discussing the vertical sections we saw that a marked difference exists between the Carnegie stations north and south of latitude 20° north. To the south of this latitude the characteristic salinity minimum of the intermediate Antarctic Current is found at all stations, but to the north of this latitude the salinity decreases toward the bottom without any intermediate minimum. The tS relation therefore is quite different at the stations north and south of latitude 20° north. In figure 2 the data for observations at stations north of 20° north and below a level of 100 meters have been plotted, using different designations for observations in the depth intervals 100 to 500, 500 to 1500, and below 1500 meters. It is seen that all values fall nearly on a mean curve. This agrees well with the corresponding curves which Helland-Hansen has derived from the observations on board the Michael Sars and the Armauer Hansen which are also shown in the diagram. A few values fall above the lines, and these originate from regions where the Mediterranean water is found.

Another feature of considerable interest is that in the northern Atlantic the occurrence of water of a certain tS relation is not restricted to certain intervals of depth. Water of high temperature and high salinity is found in the upper layers only, but in other localities in the upper layers one finds water which has the properties of the water between 500 and 1500 meters at other stations, or even the properties of the deep water. This feature indicates that a considerable vertical circulation exists within the area of the North Atlantic where the observations have been made and that the deep water may be mixed with water which has been at the surface.

To the south of latitude 20° the salinity minimum is plainly seen in the tS diagram in figure 3, which shows a much more pronounced stratification of the water. Water of a temperature above 12° is never found below 500 meters, of a temperature below 7° never above 500 meters, and of a temperature below 4° never above 1500 meters. Therefore, a direct transport of surface water down to the greatest depth does not take place in the region from which these observations originate. This result is self-evident because all the observations were taken in the tropics, but the stratification has been pointed out here because it will be shown that the corresponding stratification is more pronounced in the Pacific. Figure 4 shows the tS relation on a more open scale for depths below 1400 meters. Short vertical lines on the various curves designate the approximate limiting depths within which the respective temperature and salinity values were obtained. Such designation was not made in figure 3 on the curve for the North Atlantic (stations 1 to 19) because of the varying characteristics of the water and the relative meagerness of data for depths below 1000 meters.

The temperature-salinity diagrams for each station are shown in figures 201 to 209, I-B. Because of insufficient data, no further detailed discussion of the characteristic properties of the water at different levels and in different regions of the North Atlantic will be attempted.

Results of Dynamic Calculations

Helland-Hansen and Nansen (1926) have published maps of the eastern North Atlantic showing the topography of a number of isobaric surfaces relative to the topography of the 2000-decibar surface, and Jacobsen (1929) has published corresponding maps of the greater part of the North Atlantic using the 1000-decibar surface as a basis. Most of the Carnegie stations reach to greater depths than 2000 meters and the results, therefore, can be used for amplifying the maps by Helland-Hansen and Nansen.

Figure 5 shows the topography of the 100-decibar surface relative to the topography of the 2000-decibar surface, based on the anomalies in dynamic meters of the distances between the surfaces. The lines representing the relative topography of the 100-decibar surface are drawn for intervals of 10 dynamic centimeters. The relative flow of the water at a pressure of 100 decibars is parallel to the lines and in the direction which is indicated by the arrows. The flow of the water at a pressure of 2000 decibars is undoubtedly very slow and the lines, therefore, represent very nearly the direction of the absolute currents at the depth where the pressure is 100 decibars, or at a depth of about 100 meters below the surface.

The continuous lines in the figure have been copied, with a few simplifications, from Helland-Hansen and Nansen's map. These lines are based on numerous observations over a period of many years and must, therefore, be expected to represent nearly a true picture of the average topography of the 100-decibar surface in the stated units. The corresponding values at the Carnegie stations are entered in the same units. Some of the Carnegie stations fall within the area which has been examined by Helland-Hansen and Nansen, and the values at these stations are in excellent agreement with their map, except the value 1.30 to the northwest of the Azores. It is very probable, however, that this station is situated in a region where minor whirls occur, such as those which are indicated at other localities in Helland-Hansen and Nansen's map. The broken lines in the figure represent the relative topography of the 100-decibar surface according to the Carnegie data outside the region which previously had been studied. It is seen that these lines can be readily united with Helland-Hansen and Nansen's lines. As we proceed from north to south, along the route of the Carnegie, we recognize the Labrador Current, the Atlantic Drift, the anticyclonic circulation around the Sargasso Sea, and the north equatorial trade-wind drift, which partly continues into the Caribbean Sea.

Figure 6 shows the profile of the isobaric surfaces 0, 100, 200, 300, 400, 500, 700, 1000, and 1500 decibars along Section I, referred to the 2000-decibar surface. It is evident that the currents are strongest in the upper layers because the slopes decrease with increasing depth. It especially should be noted that the 1500-decibar surface is almost level when referred to the 2000-decibar surface, meaning that the currents at 1500 meters vary but little from the currents at 2000 meters. There are strong reasons for assuming the currents to be very weak at a depth of 2000 meters and we can, therefore, regard the relative slopes in the figure as representing very nearly the actual slopes of the surfaces. The section runs approximately north and south, and a slope to the north represents a current to the east, and vice versa.

To the right in the figure the steep slope between stations 15 and 16 indicates the Gulf Stream. The maximum velocity of this current is reached, according to the slope of the isobaric surfaces, at a level of about 200 meters. Examining the difference between the elevations of the isobaric surface above the 2000-decibar surface, we find:

	Decibars								
Isobaric surface	0	100	200	300	400	500	700	1000	1500
	Dynamic meters								
Difference in elevation (15-16)	.32	.41	.44	.41	.38	.34	.25	.12	.03

The slope of the 200-decibar surface is thus the greatest and remains considerable down to a depth of more than 1000 meters.

Aside from the maximum elevation of the isobaric surfaces at station 15 which must be associated with the presence of whirl, we find the maximum elevation of the 0-decibar surface at station 20, or in latitude about 20°, but the maximum shifts toward the north with increasing depth and at the 200-decibar surface is found at station 18, or latitude 30°. Between stations 18 and 20 we find, thus, a current which is directed toward the east at the surface but toward the west at a depth of 200 meters; below 500 meters it is again directed toward the east.

Disregarding what are probably local conditions between stations 15 and 16, the strongest westerly current is found between stations 20 and 21. This westerly current, in contrast with the Gulf Stream, has the greatest velocity at the surface, but it decreases so rapidly with depth that the current is weak below 500 meters. Examining the differences between the elevations of the isobaric surfaces we find:

	Decibars								
Isobaric surface	0	100	200	300	400	500	700	1000	1500
	Dynamic meters								
Difference in elevation (20-21)	.24	.23	.17	.13	.10	.08	.07	.05	.03

South of station 20, that is, south of latitude 20°, the current is, on the whole, directed toward the west, but irregularities appear to be present.

A corresponding examination of the profiles of the isobaric surface along the parallel of 12° north, Section II, does not produce definite results, which indicates that in this region the east and west currents are much stronger than the north and south currents.

General

Prior to the last cruise of the Carnegie the knowledge of the physical oceanography of the Pacific Ocean was based on results of expeditions which had been undertaken before 1910, the major part of these expeditions having been in the last decades of the nineteenth century. Only the expeditions in the early part of the twentieth century were equipped with accurate thermometers and carried out determinations of the salinity with the precision which now is regarded as necessary. None of the expeditions which have obtained reliable information, however, have operated at great distances from land or in the central part of the ocean. Our knowledge of the conditions of the open ocean is, therefore, primarily based on measurements which do not meet the present requirements as to accuracy. This applies especially to the observed salinities but the temperatures are also inaccurate, as will be shown later when discussing the Carnegie data in detail.

The older observations from the Pacific, however, have given a general view of the thermal and haline characteristics of the waters in the different regions and especially have thrown light over the major features of the stratification of the waters. It has been possible to draw conclusions as to the circulation of the upper strata of the ocean but it has not been possible to disclose the character of the deep-water circulation.

The woeful lack of knowledge concerning the temperature and salinity of the deep water of the Pacific prior to the Carnegie observations is illustrated in figure 7 which shows the location of stations at which observations of temperature and salinity for depths greater than 3000 meters had been made by earlier expeditions (according to Wüst), as compared with those of the Carnegie.

Schott and Schu (1910) have discussed the temperature of the Pacific waters on the basis of the entire material which was available at that time. The isothermal maps which these authors have drawn for the different levels give a good general view of the distribution of temperature, and the major features in their maps are undoubtedly correct.

Conclusions as to the circulation can hardly be drawn on the basis of temperature maps only. Wüst (1929) made use of the observations of density and salinity which had been made on earlier expeditions for the construction of two salinity sections, one representing the salinities in the western part of the Pacific and the other the salinities in the central part. He also constructed temperature sections. The sections through the western Pacific are based, to a considerable extent, on the later observations of the Planet expedition and therefore are more trustworthy than the sections from the central Pacific which are based only on the Challenger's observations, except for the most northern and southern regions. It will be shown later that the temperatures of the Challenger cannot be regarded as having the accuracy which Wüst assumed, and that the salinities which were used for constructing the sections are inaccurate in spite of the great improvements which Wüst introduced by his methods. But, notwithstanding the deficiencies in material, the sections give a correct representation of the more conspicuous features of the stratification of the waters. We shall, therefore, briefly discuss these sections in order to obtain a general view of the conditions in the region which later will be treated more in detail by means of the Carnegie observations. Since it is possible to construct a new section from the Carnegie data, however, we shall use this as representative of the central Pacific and use the section by Wüst for the western Pacific. The Carnegie section for the central Pacific deviates in important details from the corresponding section by Wüst, but the major features in which we now are interested are the same. The four sections with which we are dealing are represented in figures 8 to 11.

The temperature distribution (figures 8 and 10) in the Pacific Ocean is almost symmetrical as to the equator in contrast with the temperature distribution in the Atlantic. In the Pacific we find accumulations of warm water both in the Northern and Southern hemispheres. In the central Pacific the warm water reaches almost to the same latitude in both hemispheres, but in the western Pacific the extension toward the south is greater than the extension toward the north. In both sections the warm water reaches deeper in the Southern Hemisphere and here we have, therefore, the greater accumulation of warm water. In both sections, at about latitude 10° north we find only a very thin layer of warm water, but the highest temperatures for 1000-meter depths are found in this latitude. In both sections the temperature decreases rapidly down to a depth of a few hundred meters. From this depth the decrease continues slowly and regularly to the bottom. The isotherms in the western section show several bends but in the central section they have a smooth course. There we find none of the temperature inversions so characteristic of the corresponding sections from the Atlantic and Indian oceans.

The salinity distribution (figures 9 and 11) does not show such a pronounced symmetry as the temperature distribution. The accumulation of water of high salinity is more conspicuous in the Southern Hemisphere where the vertical extension is greater and where it reaches a greater distance from the equator. This accumulation is more developed in the western than in the central section. The accumulation in each hemisphere is separated from the other by a belt of water of low salinity which follows approximately the parallel of 10°, the same latitude in which the isotherm of 20° approaches the surface.

Below the accumulations of water of high salinity in both hemispheres we find water of very low salinity which appears to penetrate toward the equator from the subarctic and subantarctic regions, representing the intermediate subpolar currents. In the Atlantic this intermediate current is developed only in the Southern Hemisphere but reaches across the equator up to about latitude 20°. In the Pacific the intermediate current appears to be developed almost to the same extent in both hemispheres. In the Northern Hemisphere it penetrates to almost 15° in both the central and western sections; in the Southern Hemisphere it penetrates to almost 20° in the central section and to 30° in the western section. In these sections, however, the salinity curve 34.4 per mille has been used as representing the last traces of the intermediate water, but if 34.5 per mille had been used, we would have found that the intermediate water penetrates to between latitudes 15° and 10° in the Northern Hemisphere and to between latitudes 0° and 10° in the Southern Hemisphere.

Between the last traces of the intermediate water, in the equatorial part of both sections, we find water of

a salinity which is lower than the salinity of both the surface and the deep water.

The deep water which fills the Pacific Basin below a depth of 2000 meters, is, according to these sections, of a very uniform character, with a temperature slightly below 2° and a salinity somewhat above 34.6 per mille.

Defant (1928) has pointed out the advantage of distinguishing between two different horizontal strata in the sea, namely: an upper stratum, the troposphere, within which great variations of temperature and salinity in horizontal and vertical directions are found, and to which the most important currents are confined; and a deeper stratum, the stratosphere, which is characterized by small variations in temperature and salinity both in horizontal and vertical directions, and consequently, by very slow currents. In the Pacific, in accordance with Wüst, we may regard the isothermal surface of 10° as separating the troposphere from the stratosphere. We find then that the troposphere has a maximum vertical extension of about 650 meters in the western Pacific and of less than 500 meters in the central Pacific, and that the stratosphere reaches to the surface of the sea north and south of latitudes about 50° north and south, respectively. The circulation within the troposphere, also in accordance with Wüst, will be called the warm-water circulation, and the circulation within the stratosphere will be called the cold-water circulation.

The Available Data

The observations of the Carnegie are not so numerous that by means of these we can undertake a complete discussion of the physical oceanography of the Pacific. Most of the observations were made north of latitude 20° south. Observations south of this latitude are available only from the South American coast to longitude 120° west. Thus no stations were occupied in the greater part of the South Pacific south of latitude 20° south, and in the North Pacific great regions have not been visited. Considering these wide gaps, it might appear desirable to amplify the data of the Carnegie by means of data from earlier expeditions, in order to make the best possible use of the existing material in the following discussion. None of the earlier observations from the Pacific, however, are of the same quality as to accuracy as the Carnegie data except later observations which have been taken off the coast of California, in the Gulf of Alaska, in the Japanese waters, and the observations of the Planet between New Guinea and Japan. Most of these observations do not reach to as great depths as those at the Carnegie stations. They are well suited for the study of details in the different regions but they contribute little to the knowledge of the major features which enter in the foreground when dealing with the work of the Carnegie. We shall, therefore, make use only of some stations in the Gulf of Alaska which directly form a supplement to the Carnegie stations in this region.

As to the older observations, it has already been emphasized that these are less accurate than the later ones. In order to illustrate this the vertical temperature distribution at three Challenger stations and three Carnegie stations (which were taken in approximately the same localties) is represented in figure 12. It is seen that the general features of the temperature distribution agree well, but the results differ considerably in details. Comparing the stations Challenger 254 and Carnegie 143 we find that the Carnegie observations show a decrease of the temperature at all levels, whereas the Challenger observations show three inversions. The two lower inversions, however, fall between levels at which the Carnegie observed, and at the latter levels agreement exists between the Challenger and Carnegie temperatures. It is possible, therefore, that the inversions existed when the Carnegie station was occupied but escaped detection because the observations were made at too great intervals. A comparison between stations Challenger 262 and Carnegie 139 shows that this conception can hardly be upheld. The Carnegie station again shows a decrease of temperature at all levels, whereas the Challenger station indicates a succession of intervals with small decrease or inversions. At this station the intervals of the Carnegie observations are again much greater than the intervals of the Challenger observations, but a Carnegie observation was made at the level at which a Challenger observation indicates an intermediate minimum of 1°56. The Carnegie observation shows no such minimum but the value lies practically on the straight line joining the two adjacent observations. The irregularities of the Challenger values which occur above a level of 500 meters are actually of the same order of magnitude as the irregularities at a greater depth but they are less conspicuous because of the rapid change of temperature with depth. The observations at the two stations Challenger 280 and Carnegie 87 agree, on the whole, very well but below a level of 800 meters the Challenger temperatures appear to be as much as 0°3 too high.

These three examples show that the reality of the small inversions which were observed at great depths on the Challenger must be doubted and the same also applies to the intervals with small temperature gradients in the upper layers. Such irregularities are never found at the Carnegie stations, as is evident from the temperture curves of the following figures reproduced in I-B: 94, 100, 106, 112, 118, 127, 133, 142, 148, 154, 160, 166, 172, 178, 187, and 196.

It is true, as already mentioned, that the Carnegie observations have been made at greater intervals than the Challenger observations, but if inversions at great depths were as frequent as indicated by the Challenger data, they would undoubtedly have been observed at some stations and have changed the smooth course of the curve. Considering this circumstance we cannot agree with Wüst in accepting the small inversions as representing actual conditions. The Carnegie observations strongly indicate that, although the Challenger data give a true representation of the major features of the temperature distribution, the details cannot be relied on. This result is in agreement with the conception of the officers of the Challenger because, in the report on the deep-sea temperature observations, smooth curves have been drawn by means of the observed data and the values scaled from curves have been given beside the observed values. The smooth curves agree, on the whole, with the Carnegie curves, and the results from the upper layers could be used for amplification of the Carnegie data, but the deep-sea temperatures from the two expeditions are not comparable.

With the exception of the later expeditions referred to previously, the observations of temperature by the other expeditions which have cruised in the Pacific have not been made by means of more superior methods. It is not advisable, therefore, to combine the results of

these earlier expeditions with the Carnegie results. The same applies, to a still greater extent, to the salinities. Numerous observations of the salinity have been made by the Challenger but, as stated before, these have not the accuracy which permits combination with modern data. The following discussion of the physical oceanography of the Pacific will be based, therefore, principally on the Carnegie data alone.

Temperature and Salinity

Horizontal Distribution

The values of temperature and salinity, scaled from graphs for each station, have been entered in figures 210-233; I-B, and isotherms and isohalines have been drawn in order to bring out the characteristic features. It must be emphasized, however, that at the higher levels these lines have no well-defined physical significance. They do not represent the values at a given moment nor the mean annual values because the observations have been made in different seasons in the different regions.

In the upper layers great deviations from the average annual conditions must be expected because of seasonal variations in heating and cooling. In the courses of the currents and because of irregular changes, but at greater depths, such variations are probably small and here the lines can be expected to represent the average conditions, although they are based on a small number of observations.

By means of earlier observations, Schott and Schu (1910) have prepared charts showing the horizontal distribution of temperature at different levels down to a depth of 4000 meters, and Schott (1928) has published a chart showing the distribution of the salinity at the surface. In the following we shall undertake some comparisons between these charts and those derived from the Carnegie data.

Surface.--At the surface (figure 210; I-B) the temperature in the Northern Hemisphere decreases regularly from the equator toward the north in the western part of the Pacific. In the eastern part of both hemispheres the isotherms are bent toward the equator but more so in the Southern Hemisphere, where a region of low temperature can be followed along the equator from the Peruvian coast toward longitude 150° west. In the western part of the ocean a corresponding bend of the isotherms toward the equator is found to the northeast of Japan, going from Bering Sea down to latitude 40° north.

The chart by Schott and Schu shows the mean annual isotherms and, therefore, it cannot be expected that the Carnegie data will agree with the chart values because of the annual variation of the surface temperature. The Carnegie observations were made in summer in both hemispheres, for which reason they must be higher as a rule than the means for the year. Comparing the Carnegie data with the corresponding values which can be read off the Schott-Schu chart, we find that the Carnegie temperatures generally are higher. The most striking exception is in the vicinity of the Galapagos Islands, where, at stations 41, 42, 43, 44, and 45, the average deviation from the chart values is -2°2.

It is not possible to reduce the Carnegie observations to the mean of the year because sufficient data as to the annual variation are lacking. The Marine Imperial Institute at Kobe, Japan has published mean monthly isotherms for the greater part of the North Pacific, but the charts do not cover the entire area in question. For the equatorial regions Puls (1895) has published monthly isotherms, but these do not quite agree with the above-mentioned in the areas where the two representations overlap. In order to eliminate the effect of changes in the currents on the temperature distribution (Helland-Hansen, 1930) it would be necessary, furthermore, to take the salinity variations into account, but isohalines for each month are not available. The foundation for a reduction of the observed temperatures to the mean of the year is, thus, insufficient, but we can draw attention to the character of the differences between the Carnegie values (C) and the mean annual temperatures as represented by Schott and Schu (SS) and by Japanese charts (Jap). We also shall examine the differences between the Carnegie data and the corresponding mean monthly values as shown in Japanese charts and in those by Puls.

Forming mean values we find for the North Pacific,
from stations 98 to 140: C - SS = +1°9,
C - Jap (year) = +2°0,
C - Jap (month) = +0°7;
for the equatorial regions, from stations 35 to 47:
C - SS = -1°1,
C - Puls = -0°1;
from stations 70 to 74, 93 to 109, 138, 139, and 149 to 162: C - SS = +1°5,
C - Puls = +0°5.

The differences between the Carnegie observations and the values from the Schott-Schu chart are shown in table 7, where they have been arranged in groups according to the latitude, and where the months in which the observations were taken, are shown. The table also contains the differences in salinity according to the Carnegie observations and Schott's chart to which we shall return presently. In this place it will be pointed out that the Carnegie observations give the relatively highest temperatures in the middle part of the North Pacific in the months of September and October and the relatively lowest values, aside from the conditions in and near the Gulf of Panama, in the equatorial region in April and May.

Table 7. Differences in temperature and salinity between the Carnegie observations (C) and the values from charts by Schott and Schu (SS) and Schott (S)

Stations	Latitudes	Months 1928-1929	Temperature C - SS	Salinity C - S
	° °		°C	‰
35- 48	7 N-20 S	Oct., Nov.	-1.0	-0.06
49- 68	20 S	Nov., Dec., Jan.	+1.5	-0.34
69- 93	10 S-20 S	Jan., Feb., Mar.	+2.1	-0.18
94-108	20 S-20 N	Apr., May	+0.3	-0.23
109-129	20 N	May, June, July	+2.0	-0.20
130-149	20 N	Sep., Oct.	+3.6	+0.01
150-162	20 N-20 S	Oct., Nov.	+1.5	-0.19

These features, and the fact that the differences are reduced when comparing with monthly charts, indicate that the discrepancies between the Carnegie observations and the annual values according to Schott and Schu principally are because of the annual variation of the surface temperature, but part of the variation is probably connected with accidental changes in the currents.

The surface salinity (fig. 222; I-B) shows a less symmetrical distribution than the temperature. Two maxima of salinity are found, one in the Southern, and one in the Northern Hemisphere. The former has its center in the eastern part of the ocean in approximately latitude 20° south and longitude 120° west, whereas the latter has its center in the western part of the ocean in approximately latitude 25° north and longitude 175° east. These two areas of high salinity are separated by a narrow belt of low salinity in about latitude 10° north, the lowest salinities occurring in the eastern part of the ocean. Near Central America the salinities are very low, probably because of local conditions. To the north and the south of the areas of high salinity, the surface salinity decreases toward the poles. This decrease appears to be greater in the Northern Hemisphere, where salinities approaching 32.5 per mille are found in the inner part of the Gulf of Alaska and to the northeast of Japan.

The chart of the surface salinity by Schott represents approximately mean annual isohalines, but in several regions the observations on which the mean annual values are based, are distributed unevenly over the year and the actual annual values may, therefore, deviate somewhat from the values of the chart.

The Carnegie data are smaller than the values by Schott on the whole. Negative differences are found in eighty-seven of one hundred and twenty-eight cases and positive differences in nineteen cases only. As a rule, the differences are small and equal to or smaller than 0.3 per mille in ninety-one instances. The mean of all is -0.17 per mille.

Within the equatorial region no relation exists between the simultaneous deviation from the mean values of temperature and salinity. This becomes evident when plotting the corresponding values in a temperature-salinity diagram, and is also evident from table 7, which contains the corresponding average values for certain regions. Outside the equatorial regions, on the other hand, we find a distinct relation between the corresponding deviations: on the average a high temperature corresponds to a high salinity, and vice versa. This is seen when plotting the corresponding deviations and is also evident from table 7 where, within the three areas outside the equatorial regions, we find for values of t, 1°5, 2°0, and 3°6 and the values of S are -0.34, -0.20, and +0.01 per mille, respectively.

An increase of 1° in the temperature deviation thus appears to correspond to an increase of 0.15 per mille in the salinity deviation. This increase corresponds to the normal temperature-salinity relation which is found in the Pacific. The relation found between the deviations from the chart values, thus can be interpreted to indicate either that the annual variations in temperature and salinity are parallel to one another, or that part of the temperature deviations have nothing to do with the annual variation of temperature but are caused by changes in the currents and, therefore, are accompanied by parallel variations in salinity. At present it is impossible to decide which of these factors is of the greater importance.

One hundred-meter level.--At this level the temperature distribution (fig. 211; I-B) is already materially changed and the difference between the conditions in the eastern and western parts of the ocean is much more pronounced. Here we find a temperature of 12° off Callao, which increases as one proceeds toward the west, reaching 20° at the meridian of 100° west, whereas at the surface the corresponding temperatures are 18° and 23°. Off San Francisco we find a temperature of 9° increasing to 14° at the meridian of 140° west, whereas the corresponding surface values are 13° and 16°. The most conspicuous feature, however, is that north of the equator in about latitude 10° north and longitude 140° west a temperature of 11° is found where the surface value is about 24°.

Comparing the Carnegie observations at 100 meters with the values by Schott and Schu, we find deviations of a less systematic character than at the surface. Within wide areas the deviations are small and of changing sign, the mean of all being 0°37. Deviations greater than 5° are found off Japan, to the south of Bering Sea, and to the north of the equator between the parallels of 5° and 15° north, in the region of the Equatorial Countercurrent.

The Schott-Schu chart shows a belt of temperatures below 20° stretching across the ocean in about latitude 10° north and separating the warm water masses of the two hemispheres. In the figure this belt of low temperatures is shown in the eastern part of the ocean only, but it must be admitted that in the western part the distances between the stations are so great that the feature may have escaped observation.

The seasonal variation of temperature due to the influence of heating and cooling is probably very small at the 100-meter level (Helland-Hansen, 1930). The difference, therefore, cannot be ascribed to such seasonal variations, but must be related to changes in the currents. These changes may be of an accidental or periodic character and influence both temperature and salinity distribution. We have no means of examining corresponding temperature and salinity deviation, but the fact that the greatest differences in temperature occur in regions where strong and varying currents prevail, indicates that the discrepancies are owing to displacement of these currents.

The distribution of the salinity at the 100-meter level (fig. 223; I-B) shows the same features as at the surface, but the difference between the western and eastern part of the ocean is more pronounced. Very low salinities are found off the Peruvian and Californian coasts. The minimum north of the equator is less pronounced.

Two hundred-meter level.--The temperature distribution (fig. 212; I-B) shows a new and interesting feature. At this level the belt of low temperatures to the north of the equator can be followed across the ocean as far as the observations are extended, and a similar belt appears to be present directly to the south of the equator, whereas higher temperatures prevail at the equator.

The typical region of low temperature, which at higher levels could be followed from the coast of Peru toward the west along the equator, has now moved to the south and is found entirely in the Southern Hemisphere.

In the Schott-Schu chart only one belt of low temperatures to the north of the equator is seen, the second belt to the south of the equator is not present. It is possible that the existence of the two belts is connected with the special development of the currents at the time when the Carnegie observations were made, but even if this is the case, the feature is characteristic of the conditions in the central Pacific.

The average discrepancy between the Carnegie observations and the corresponding values according to

Schott and Schu is of the same order as at the 100-meter level and the greatest deviations are found, as previously, where strong currents prevail.

The character of the salinity distribution (fig. 224; I-B) is not much changed except that the difference between the conditions in the northern and southern parts of the ocean is more prominent. In the Northern Hemisphere salinities above 35 per mille occur only within a narrow strip where the temperature exceeds 20°, whereas in the Southern Hemisphere salinities above 35 per mille are found over a wide area stretching toward the east into regions where the temperature is considerably lower than 20°. Here isolated areas with a salinity above 36 per mille are present. Off the coast of Chile we find a tongue of low salinity in the region where a corresponding tongue of low temperature is present.

Three hundred-meter level.--At this level we find, principally, the same distribution of temperature (fig. 213; I-B) as at 200 meters. The two belts of low temperatures on both sides of the equator and the high temperatures between them appear more clearly, and the tongue of low temperatures off the Peruvian coast has moved somewhat farther south. The warm-water accumulations in both hemispheres are more clearly separated.

The distribution of salinity (fig. 225; I-B) is more uniform than at higher levels. In the Northern Hemisphere the accumulation of water of high salinity is seen in the eastern part only, but the values do not exceed 34.7 per mille. In the Southern Hemisphere the accumulation of very salty water is still fairly well developed with values above 35 per mille in a wide region.

In both hemispheres tongues of low salinity penetrate toward the equator in the western part of the ocean. In the Northern Hemisphere the tongue nearly coincides with a corresponding tongue of low temperatures, but in the Southern, the low salinities are found considerably more to the south than the low temperatures.

Four hundred-meter level.--The temperature distribution (fig. 214; I-B) is principally the same as at 300 meters, but the differences between the values in different parts of the ocean are smaller. At this level a connection is clearly seen between the two equatorial belts of low temperature and the tongue of low temperature in the western part of the ocean. The discrepancies between the Carnegie data and the Schott-Schu chart are of the same character as previously.

The salinity distribution (fig. 226; I-B) also shows the same features as at 300 meters, but now only traces of the accumulation of water of high salinity are present, and the tongues of water of low salinity on the western side of the ocean are still more pronounced.

Five hundred-meter level.--Here we find again a similar distribution of temperature (fig. 215; I-B), but the high temperatures at the equator appear more clearly and to the north of the equator we find alternating high and low temperatures where, at higher levels, there was a belt of low temperatures only. The highest temperatures are found in the Northern Hemisphere where there are values above 10° in the eastern part of the ocean.

The distribution of salinity (fig. 227; I-B), on the other hand, is much changed as compared with the distribution at higher levels. At 500 meters we find no trace of accumulations of water of high salinity in either hemisphere, but the maximum values are found along the equator where, however, they remain lower than 34.65 per mille. The tongues of low salinity on the western side of the ocean are still present, and in the Northern Hemisphere salinities lower than 34.1 per mille appear to be characteristic of the entire central part of the North Pacific.

Seven hundred-meter level.--Here the temperature contrasts (fig. 216; I-B) are still smaller, but the character of distribution is not much changed. Traces of the warm-water accumulations are still seen in both hemispheres, and the characteristic tongues of low temperatures at the western side of the ocean can be followed.

At this level the highest salinities (fig. 228; I-B) are also found at the equator, but the values nowhere exceed 34.60 per mille. In the Southern Hemisphere a tongue of low salinity is still present at the western side of the ocean, but in the Northern Hemisphere the corresponding tongue has disappeared and the lowest values are found in the central part of the North Pacific.

One thousand-meter level.--At this level a considerable change in the character of the temperature distribution (fig. 217; I-B) has taken place. In the equatorial region we find alternating strips of low and high temperatures. In the Northern Hemisphere the temperature decreases fairly regularly toward the north, but now there are high temperatures off the coast of California, where at higher levels low temperatures prevail. In the Southern Hemisphere the tongue of low temperature in the western part of the ocean is still present, but it has been displaced somewhat to the south.

At this and lower levels the charts by Schott and Schu show higher temperatures, on the whole, than do the Carnegie observations. Detailed comparison is of minor interest because the data on which the charts are based are less accurate than the Carnegie observations. The distribution of the salinity (fig. 229; I-B) is very similar to the distribution at 700 meters, but the contrasts are smaller and the maximum values in the vicinity of the equator are also smaller.

Fifteen hundred-meter level.--Here the temperature distribution (fig. 218; I-B) in the Northern Hemisphere has the same character as at 1000 meters, but in the Southern Hemisphere the characteristic tongue of low temperatures has disappeared, and instead, a tongue of high temperature stretches toward the south in longitude 95° west. As to the distribution of the salinity (fig. 230; I-B), the maximum values are still found in the equatorial region and are now slightly above 34.6 per mille and the low values in the central part of the North Pacific have almost disappeared.

Two thousand-meter level.--The temperature distribution here (fig. 219; I-B) is similar to the distribution at 1500 meters, but the contrasts are smaller. The highest temperatures, above 2.°3, are found near the equator, whereas the lowest values, 1.°8, are directly to the south of Bering Sea. The salinity (fig. 231; I-B) is higher than at 1500 meters. Values below 34.6 per mille are found off the coast of Chile, in a limited area near the Samoan Islands, and in the greater part of the North Pacific.

Twenty-five hundred-meter level.--At this level the temperature distribution (fig. 220; I-B) shows new and interesting features. Temperatures above 1.°9 are found in the vicinity of the equator and in the southern part of the South Pacific, whereas in the northern part of the South Pacific temperatures slightly below 1.°9 appear to prevail. In the North Pacific an area with temperatures below 1.°7 covers the northern part, but in the Gulf of

Alaska, to the south of Bering Sea, and off the coast of Japan, slightly higher temperatures are present. The distribution of the salinity (fig. 232; I-B) at this level is so uniform that no isohalines can be drawn, but a general decrease of the salinity from south to north appears to be characteristic at this level. Values approaching or slightly surpassing 34.7 per mille are found at the most southern stations, whereas in the North Pacific the salinity is only slightly above 34.6 per mille.

Three-thousand-meter level.--The temperature distribution (fig. 221; I-B) here is very uniform. Near Central America values above 2°0 are observed, but elsewhere the temperature varies between 1°85 in the basin off the Peruvian coast to 1°55 in the central part of the North Pacific. The lowest values again appear to be present in the northern part of the North Pacific, whereas high values prevail in the equatorial region. The material is very scanty, but the variations are sufficiently systematic to give significance to the isotherms which have been drawn. At this level the salinity (fig. 233; I-B) appears to decrease from south to north, varying from 34.68 per mille in latitude 40° south to 34.63 per mille in latitude 40° north. In the southern part the values are approximately the same as at 2500 meters, but in the northern part they are slightly higher.

Concerning the salinities it must be added that these, according to the discussion given on page 72, appear to be about 0.03 per mille too low. This systematic error is of no importance in the upper levels but at great depth it exerts an influence on the course of the isohalines.

The warm water of the Pacific.--We have seen that at the 700-meter level the distribution of both temperature and salinity is quite different from the distribution at higher levels. Therefore, we conclude that the warm-water circulation in no locality reaches as far down as the 700-meter level. At the 500-meter level traces of this circulation were seen in the temperature distribution only, and considering that the temperature at 500 meters is lower than 10° and that we have previously regarded the isothermal surface of 10° as representing the lower boundary of the troposphere, we conclude that the warm-water circulation practically has disappeared below the 500-meter level.

Intermediate water of the Pacific.--The intermediate water of low salinity is first clearly seen at the 400-meter level in the eastern part of the North Pacific where the low salinities off the Gulf of Alaska continue toward latitude 25° and bend toward the west somewhat to the north of this latitude. The isotherms show a corresponding but less pronounced bend toward the west. In the Southern Hemisphere the corresponding intermediate current appears to be present in the region to the west of South America. At the 500-meter level the intermediate current evidently reaches farther west in the Northern Hemisphere as indicated by the course of the isohalines and also by the characteristic bend of the isotherms. At the 700-meter level the intermediate current is less strongly developed in the eastern part of the North Pacific where the salinities now are higher than at the 500-meter level. The lowest salinities are now found farther west. In the Southern Hemisphere the intermediate current can be traced up to about 15°. At the 1000-meter level we are evidently below the intermediate current because the salinities are higher here than at 700 meters both north of latitude 20° north and south of latitude 20° south. The intermediate current thus appears to be most strongly developed between depths of 400 and 700 meters in the Northern Hemisphere, and to lie at a higher level in the eastern part of the ocean. In the Southern Hemisphere it appears from the horizontal charts to be most prominent at a level of 700 meters. The last traces of the intermediate currents do not reach to lower latitudes than about 15° and 10°. Between these latitudes we find water of a uniform salinity which is higher than the salinity of the intermediate currents but lower than the salinity of the deep water.

Deep water of the Pacific.--The deep water of the Pacific is very uniform; the temperature decreases slowly with increasing depth and the salinity increases slowly. In a horizontal direction we find a decrease of salinity from south to north and maximum temperatures at the equator, but the total range of temperature is less than 0°2, except the local conditions near Central America. The uniform character of the deep water is illustrated by the following table, which shows average values of temperature and salinity at the depths 2000, 2500, and 3000 meters within stated intervals of latitude. It is seen seen that the range of the average temperatures decreases slowly with depth whereas the range of the average salinities remains equal to 0.04 per mille, and the absolute values decrease from south to north at each level. But as a result from a general discussion of the salinity values, it seems probable that salinities as tabulated and graphed should be increased by 0.03 per mille. The discussion on which this conclusion is based is presented in Physical Oceanography I-B of the "Scientific results of cruise VII of the Carnegie."

Vertical Distribution

When discussing the horizontal distribution of temperature and salinity we considered the most prominent features of the vertical distribution and especially emphasized that the waters of the Pacific show a typical stratification both as to temperature and salinity. Turning to a more detailed discussion of the vertical distribution, we shall base this on the representations in the vertical sections and shall also make use of the curves which show the observed data at each station. As to the construction of the sections we refer to the explanation of the graphs.

Section III.--Section III embraces stations 37 to 40 and 60 to 72, begins near the Gulf of Panama, follows the coast of South America down to latitude 17° south, and continues south-southwest to latitude 40° south. Two stations in the Gulf of Panama, stations 35 and 36, were not included when constructing the section.

The topmost layer of the troposphere has been called by Defant the zone of agitation (Størungszone), representing the layer within which convection currents can mix the water thoroughly. It is perhaps better to use the term convection layer because this term better expresses the character of this uppermost stratum.

Off Central America the convection layer is very thin. At station 35 it does not reach to 27 meters and has a salinity of 29.8 per mille and a temperature of about 27°5. At stations 36, 37, 38, and 39 the thickness of the layer is between 20 and 30 meters. The salinity increases up to 33 per mille at station 39. The temperature is about 27° at the previous three stations and

about 25° at station 39. At station 40 the convection layer has a thickness of less than 23 meters, the salinity is slightly above 34 per mille but the temperature is only 20°.4. At the next stations, 69 to 72, we also find a very thick convection layer which never reaches to a depth of 40 meters. The surface salinity is higher here, being above 35 per mille, but the temperature is low especially at station 71 which has been taken at a short distance from the coast. Proceeding toward the south along the section we find that the convection layer remains thin at all stations, but the transition from the convection layer to the deeper layers becomes more and more gradual. This is especially evident when we take the density into account. At station 71 we have, for instance, an increase in σ_t from 24.05 at 19 meters to 25.36 at 40 meters, whereas at station 60, σ_t increases only from 25.32 to 25.51 between 24 and 47 meters.

The heating by radiation and contact with the atmosphere and the influence of evaporation and precipitation are primarily responsible for the temperature and the salinity of the convection layer, but transport of water from deeper layers may also be of importance. In this place we shall especially emphasize that the low salinity in the region of Central America must be ascribed to the influence of precipitation because we have no inflow of water of low salinity to this region, and because no large rivers carry considerable quantities of fresh water into the sea. The high salinities off the Peruvian coast, on the other hand, must be attributed to the effect of evaporation because this water is transported toward the coast from the south where the salinity is lower, or to the effect of "upwelling" which brings water of higher salinity to the surface.

Below the convection layer we find a more or less rapid decrease of the temperature with increase with depth. The decrease is especially very rapid at the stations which have been taken at a short distance from the coast of Peru, but is more gradual at the southern stations. The isotherm of 15° sinks from stations 60 to 67 and rises between stations 67 and 70. The isotherm of 10° also sinks between stations 60 and 67 but up to station 71 this isotherm continues sinking and runs horizontally north of this station. The isotherm of 5°, on the other hand, runs almost horizontally up to station 67 and sinks from this station as it proceeds to the north. The rise of the isotherm of 15° between stations 67 and 70 indicates an accumulation of cold water in the upper layer; but this accumulation does not reach below the level of the 10° isotherm and is thus a phenomenon of the troposphere.

The distribution of the salinity is much more complicated except in the northern part of the section where the salinity decreases regularly down to a depth of 1000 meters. South of station 72 we find many irregularities in the vertical variation of the salinity at the different stations, but in the section two major features are seen. The salinity of the water above a depth of about 200 meters increases, on the whole, from south to north. As already mentioned, this increase must be attributed to the influence of evaporation because it is more rapid at the surface. The tongue of low salinity, which extends from station 68 to station 70 at a depth of 150 to 200 meters, is probably associated with an upwelling movement in the upper layers. Below a level of 400 meters we find a layer of minimum salinity representing the intermediate antarctic current. The axis of the lowest values sinks from a little less than 500 meters at station 60 to about 700 meters at station 69, and in the same distance the salinity increases from 34.2 to 34.5 per mille. The axis practically follows the isotherm of 6°. To the north of station 69 water of salinity between 34.5 and 34.6 per mille is found between depths of about 500 and 1500 meters.

The deep water below a level of 2000 meters has a very uniform character. The salinity increases slightly toward the bottom.

In the Peruvian Basin the temperature appears to have a constant value of 1°.83 below a level of 2700 meters, but at the southern stations, 60 to 66, the temperature decreases with increasing depth. The lowest temperature was found at station 60 where 1°.23 was observed at a depth of 3617 meters, 400 meters above the bottom.

Section IV.--Section IV, comprising stations 45 to 51, also represents a section approximately north and south in the same general region but at a greater distance from the coast. Here the convection layer has a considerably

Table 8. Deep-sea temperatures (t) and salinities (S) in the Pacific arranged according to latitude

Area		Number of Stations	Depth in meters					
			2000		2500		3000	
Latitude	Longitude		t, °C	S, ‰	t, °C	S, ‰	t, °C	S, ‰
° 53 N 40 N	° 153 E 120 W	12	1.91 (12)	34.58 (12)	1.71 (11)	34.61 (11)	1.62 (7)	34.63 (7)
40 N 20 N	140 E 120 W	29	2.04 (29)	34.59 (29)	1.74 (27)	34.62 (27)	1.60 (19)	34.63 (19)
20 N 0	140 E 130 W	18	2.19 (16)	34.62 (16)	1.84 (15)	34.63 (15)	1.69 (12)	34.64 (12)
0 20 S	180 70 W	44	2.20 (42)	34.62 (42)	1.89 (41)	34.64 (41)	1.77 (24)	34.66 (24)
20 S 41 S	120 W 70 W	20	2.17 (19)	34.62 (19)	1.90 (18)	34.65 (18)	1.76 (12)	34.67 (12)
Maximum - minimum			0.29	0.04	0.19	0.04	0.17	0.04

Numbers in parentheses indicate number of stations included. Salinities probably 0.03 o/oo too low.

greater thickness, especially in the central part of the section, where at station 48 it reaches to almost 80 meters, and at station 45 it exceeds 60 meters, but at station 51 it reaches to less than 25 meters. The zone of rapid transition sinks as one proceeds to the south along the section. The distribution of temperature does not show any other conspicuous features.

The salinity has high values at the surface, surpassing 36.00 per mille between stations 47 and 50. A tongue of salinity above 36.00 per mille stretches past station 47 to the north, which indicates a transport of water of high salinity at a depth of about 100 meters. In the southern part of the section the intermediate antarctic current is recognized by the tongue of low salinity at a level of about 700 meters. The axis of the lowest values apparently rises as it proceeds toward the north and reaches a level of about 600 meters to the north of station 48. The axis again nearly coincides with the isotherm of 6° and this isotherm shows a corresponding but smaller rise. The deep water has the same uniform character as in the preceding section.

Section X.--Section X (stations 51, 52, and 55 to 60) runs from southeast to northwest from station 51 to 60. The convection layer is thin at all stations, and exceeds 30 meters only at stations 55, 56, and 57. The isotherms sink toward the northwest in the upper layers, which indicates that we approach the warm-water accumulation. Below 800 meters they run horizontally.

The salinities are also highest to the northwest, where values above 35.5 per mille are found, and where the course of the isohalines indicates that water of high salinity is spreading toward the southeast. In the most southeastern part of the section we find very low surface salinities, probably characteristic of the easterly current in this region. The decrease of the surface salinity in a horizontal direction is especially rapid in the region of station 57, and here the northern limit of the easterly current may be sought. The belt of salinity below 34.4 per mille at a depth of 600 to 800 meters represents the intermediate antarctic current. The axis of the lowest values is found at approximately 800 meters at station 51 and rises to about 650 meters at station 60. At stations 51 to 57 the axis follows the isotherm of 5° but at stations 58 to 60 it follows the isotherm of 5°5. The isotherms in these layers, however, also show a rise toward the southeast which corresponds to the rise of the axis. The deep water has a temperature which decreases regularly with increasing depth, but the salinity of the deep water shows a more irregular distribution. At stations 58 to 60 salinities above 34.7 per mille have been observed, being the highest values which were found below the 2000-meter level.

Section XI.--This section (stations 71 to 93) runs practically east and west, and follows approximately the parallel of 18° from the Peruvian coast to the Samoan Islands.

In the eastern part of the section, off the South American coast, the convection layer is very thin, only about 20 meters as a rule, but the thickness increases toward the west and exceeds 50 meters at several stations.

In the western part of the section, which is taken in the central region of the South Pacific Ocean, we find an accumulation of warm water which reaches to a depth of more than 400 meters, if we regard the isotherm of 10° as representing the lower limit of the warm water. High temperatures, above 25°, are found to the west of station 78 only, and the isotherms of 20° and 15°, which are found at a considerable depth in the central part of the ocean, rise almost to the surface as they approach the coast. The rise of these isotherms indicates an accumulation of cold water at the coast, but this accumulation is characteristic of the upper layers only because the isotherms below 300 meters are horizontal or sinking as they near the coast. Thus all isotherms below the isotherm of 7° are found at a lower level off the Peruvian coast than in mid-ocean.

The salinity distribution in the troposphere is characterized by high values to the west of station 77. At most stations a salinity maximum is found at a short distance below the surface and this must be attributed either to the influence of seasonal variations or to the existence of subsurface currents which transport water of high salinities from regions south of the section. The isohalines rise as they approach the South American coast, which shows that the cold water at the coast has a low salinity. The salinity decreases very rapidly with increasing depth between 200 and 300 meters, and at a depth of 600 or 700 meters we find in the whole section low salinities representing the northern part of the intermediate antarctic current. The axis of the layer of low salinity sinks slightly toward the coast and runs on an average, at a level of about 650 meters in the eastern part. The temperature along the axis is nearly 5°5 over the whole distance, and the sinking of the axis nearly corresponds to the sinking of the isotherms. The bottom water is very uniform, the isotherms running nearly horizontally, but the salinity appears to be higher at the same level near the South American coast than in mid-ocean.

Section XII.--Section XII (stations 40 to 45) also runs approximately east and west and follows nearly the parallel of 2° from the South American coast to longitude 105°. The section thus represents conditions in the eastern part of the Pacific very near the equator.

The convection layer is very thin at the coast but increases systematically toward the west, and has a thickness of nearly 60 meters at station 45. The temperature in the upper layer is very low, remaining below 23° at all stations and being lower than 20° at stations 42 and 43. These stations were within the area of low temperature which, according to the chart showing the temperature distribution at the surface, stretches toward the west from the South American coast. The temperature decreases rapidly directly below the convection layer, but this rapid decrease takes place in a short distance only.

The salinities on the whole are low, especially at a short distance from the coast, and show a maximum at a level of approximately 100 meters, perhaps representing a transport of water from the southwest at this level. A layer of low salinity is also found in this section, and it lies deeper than in the previously discussed sections. The minimum is not very pronounced, the lowest values being higher than 34.5 per mille. The axis of the lowest values is found at approximately 900 meters where the temperature is about 5°. The isotherm of 5° sinks slightly toward the coast but the salinity minimum is not so well defined that the axis of this minimum can be traced with any certainty, for which reason it cannot be seen whether or not this axis deviates from the horizontal direction. The deep water is again very uniform with a temperature which decreases slowly with increasing depth and a salinity which increases slowly.

Section V.--Section V, comprising stations 130 to 134 and 148 to 162, runs from San Francisco toward the southwest to Samoa. It passes through regions of different character and we shall, therefore, first discuss the part of the section which lies between latitudes 20° north and 20° south, namely, stations 149 to 162.

At the most northern (station 149) of these stations the convection layer has a thickness of about 50 meters, but at station 151 in latitude 12° 40′ north the thickness is not much greater than 10 meters. Proceeding toward the south the thickness again increases more or less regularly and at station 160 has a value of about 100 meters. The highest temperatures at the surface are found at stations 150 and 158 to 162. The temperature decreases rapidly with increasing depth below the convection layer, and this decrease is especially rapid at stations 151 and 152, where all isotherms showing a temperature of 10° and more are curved toward the surface. At stations 151 and 152 we thus find an accumulation of water of relatively low temperature, but this accumulation only reaches a depth of about 400 meters. Below this depth the highest temperatures are found at stations 151 and 152 down to a depth of 1000 meters, but at still greater depths the temperature maximum wanders toward the south and at a level of 2500 meters is found below station 155 in latitude 4° 51′ north. It should be noted especially that the isotherm of 5° rises from its lowest position more rapidly to the north than to the south. The temperature distribution thus shows an accumulation of cold water at stations 151 and 152 down to a depth of less than 400 meters, and below this depth an accumulation of warm water is shown. These accumulations indicate an ascending vertical movement above a level of 400 meters and a descending movement below this level. The latter appears to be more pronounced to the north than to the south.

The salinity distribution in this section shows a number of remarkable features. At stations 151 and 152 the surface salinity is below 34.00 per mille and these very low values probably must be attributed to the effect of precipitation. Both to the north and to the south of these two stations the surface salinities are considerably higher, but the maximum values are found about 100 meters below the surface. The subsurface maximum is well developed especially to the south of the equator where the distribution indicates that at a level of about 100 meters a considerable transport of water of high salinity takes place toward the north. At station 150 to the north of the equator, we find a slight indication of a similar transport toward the south. The very low surface salinities which were observed between stations 159 and 162 are difficult to explain. It is possible that the flow of water of high salinity at a level of 100 meters is intermittent, and that water of low salinity may reach the surface in some localities and spread out. It is also possible that the water of low salinity, which is found to the north of the equator, occasionally spreads toward the south.

Below the layers of high salinity we find a region of low salinities between 500 and 1500 meters. To the north of station 151 water of low salinity, representing the subarctic current, penetrates toward the south. As will be shown later, it is probable that the major part of this water flows toward the east in the region with which we are dealing, but from the section it is evident that part of the water continues toward the south. This current divides into two branches, one ascending above a level of about 400 meters and the other descending below this level. The vertical distribution of the salinity thus confirms the conclusions which were drawn from the course of the isotherms as to the vertical movement. In the most southern part of the section water of a salinity below 34.5 per mille penetrates toward the north at a level of about 750 meters where the temperature is 5.°5. Between stations 151 and 158 we find water of a uniform salinity a little below or a little above 34.5 per mille.

The deep water is again of a uniform character. The temperature decreases to values below 1.°5 and at station 149 it again increases slightly when approaching the bottom. Later we shall discuss the temperature at the greatest depths. The salinity of the deep water is practically the same within the whole section.

Turning next to the northern part of the section from San Francisco to station 149 we find in this region a thin convection layer, which at all stations has a vertical extension of less than 50 meters. The lowest surface temperatures are found off the coast and here the isotherms rise rapidly when approaching the coast. This rise, however, is found only down to a depth of 400 meters, which indicates that an accumulation of cold water is confined to the upper layers. The salinities of the upper layers are very low in the vicinity of the coast where a rapid increase takes place at about 200 meters. In the section it appears as if the low salinities, which at greater distances from the coast are found at a depth of 400 meters, form a direct continuation of the low values near the surface at the coast. It will be shown later on, however, that this cannot be the case and that the water of low salinity at the coast, and the intermediate water at 400 meters belong to distinctly different currents.

Section VII.--Section VII (stations 139 to 143) represents a north and south section in the central part of the Pacific, and follows approximately the meridian of 160° between latitudes 34° and 22°. In this section the convection layer for the most part has a thickness of about 50 meters, varying from about 40 meters at station 143 to about 70 meters at station 140. At the last-named station the greatest accumulation of warm water is found, and the isotherms of the upper layers rise both to the north and to the south of the station. At greater depths the highest temperatures are found more to the north.

A small accumulation of water of high salinity is shown with its center at station 140 where the salinity reaches 35.3 per mille at about 200 meters; but the most conspicuous feature is represented by the tongue of water of salinity below 34.00 per mille extending almost to station 140. Even at station 139 a minimum below 34.1 per mille is found. The axis of the lowest values sinks toward the south in the most northern part of the section and rises continuously in the southern part. In the northern part it follows the isotherm of 6° at a level of about 600 meters, but to the south of station 141 the axis rises more rapidly than the isotherms and lies at a depth of 400 meters at station 139 where the temperature is 8°.

In the deep water both the temperature and the salinity appear to decrease toward the north. The decrease of the temperature is undoubtedly a real feature, but the decrease of the salinity toward the north below the 2000-meter level is so small that it lies within the limits of accuracy of the observations.

Section XIV.--Section XIV (stations 130 to 140) runs from San Francisco to the Hawaiian Islands in a direction

which changes from southwest to west-southwest. The eastern part of this section off the American coast has already been discussed because stations 130 to 134 were used when construction Section V.

The convection layer is thin at all the stations of the section, remaining, as a rule, thinner than 40 meters. Water of a temperature higher than 25° is found directly below the surface to the west of station 136. Below the warm surface layer the temperature decreases rapidly with increasing depth. The isotherm of 10° is met with at a depth of almost 400 meters at station 140: it rises slowly when approaching the American coast, and directly off the coast a rapid rise takes place, indicating an accumulation of cold water.

The low surface salinities off the coast have already been discussed. Proceeding toward the west, we find increasing surface salinities and values above 35.00 per mille at stations 137 to 140. The lowest salinities in this region are found at a depth of about 400 meters where the values lie between 34.00 and 34.1 per mille. The axis of the salinity minimum in the western part of the section shows minor bends up and down and follows, on the whole, the isotherm of 8°, which also oscillates up and down in a corresponding manner. The axis rises when approaching the coast, and we can regard it as following practically the same isotherm to the coast if, in the region where the salinity decreases with increasing depth, we take the value 33.95 per mille as the characteristic value of this intermediate water. The feature which should especially be emphasized is that between stations 136 and 140 this intermediate water has a salinity above 34.00 per mille and a temperature of 8° and is found at a level of 400 meters. The rise of the intermediate water as it approaches the coast should also be borne in mind.

The deep water, as previously, shows a nearly uniform temperature which decreases toward the bottom. The variations in a horizontal direction are small and appear to have an irregular character. The salinity increases slowly with depth and at the 2000-meter level no differences in a horizontal direction are perceptible.

Section XV.--Section XV (stations 142 to 146) represents a very short section which runs east and west in approximately latitude 33°. The convection layer again has a thickness of less than 40 meters. The isotherms are almost horizontal and the temperature decreases to less than 10° within the upper 300 or 400 meters.

The surface salinity is lower than 35.00 per mille at all stations except 144, and the salinity decreases with increasing depth. In the eastern part of the section several irregularities, intermediate minima and maxima, occur which indicate more or less complicated currents. A very pronounced salinity minimum with values below 34.00 per mille is shown at all stations. The axis of the lowest value rises considerably from west to east, lying at a depth of about 600 meters at station 142 and at a depth of 550 meters at station 146. It follows almost exactly the isotherm of 7° running slightly below this isotherm to the west of station 144 and slightly above this isotherm to the east of station 145.

Comparing the characteristics of this intermediate water with those of the corresponding water at stations 136 to 139 of the preceding section which lies about 10° farther south, we find that the layer of water of low salinity rises toward the south and that the salinity and the temperature of this water increase together. In both sections we find the intermediate water at a lower level when the distance from the American Continent is greatest.

Section VI.--Section VI, comprising stations 125 to 130, runs from latitude 51° 58′ north, longitude 150° 39′ west to San Francisco. The convection layer is thin and reaches a thickness of more than 50 meters at station 129 only. The surface temperature increases as one proceeds to the southeast, and remains practically constant from station 128 to the coast. The decrease of temperature with increasing depth is rapid in the most northern part, especially at station 125 where temperatures higher than 6° are found above 45 meters only. The high surface temperatures in this region appear to be the result of heating in summer. On the whole, the subsurface temperature increases toward the southeast as shown by the sinking of the isotherms in this direction. Down to a depth of about 300 meters between stations 129 and 130, however, the isotherms rise, indicating the accumulation of cold water at the coast. The observations at stations 129 and 131, combined with the data from station 130, thus reveal the same features. The sinking of the isotherm of 5° is, on the other hand, especially rapid between stations 129 and 130, suggesting a downward motion of the water at a depth of about 600 meters. A corresponding divergence of the isotherms was found between stations 68 and 71 off the coast of South America.

The surface salinities are very low at all stations, being less than 33.00 per mille in the northwestern part of the section. A rapid increase takes place at a depth of about 150 meters and below this depth the salinity increases more slowly. It is noteworthy that the increase with depth is slow at a level of about 500 meters except at the most northwestern stations. The value of the salinity in the interval having slow increase is between 33.9 and 34.1 per mille, and the temperature ranges from 7° to 3.°5 at station 127, and from 8° to 6° at station 130. It is probable that at this depth we find the water, which, in the more southerly sections, represents the intermediate water. Between stations 129 and 130 the isohalines rise at all levels and thus give no indication of a downward movement at a level of 500 meters as suggested by the course of the isotherms at this layer.

The deep water appears to be very uniform. The 2° isotherm runs practically horizontally at a level of 2000 meters, and at this depth a uniform salinity of slightly more than 34.6 per mille is found.

After this brief description of the vertical distribution of temperature and salinity in the eastern part of the North Pacific, we turn to the conditions in the western part.

Section VIII.--Section VIII (stations 94 to 104) runs mainly in a southeasterly direction from latitude 20° 12′ north, longitude 161° 19′ east to the Samoan Islands. The section thus crosses the equator and, therefore, shows a number of features which are similar to those in the southern part of Section V. When examining the section it must be borne in mind that the northern part runs almost from east to west and variations which are characteristic for the north-south direction, therefore, appear much exaggerated in our representation. This is evident from figures 32 and 33, for instance, in which the observations at stations 95 to 104 have been used for the construction of true north and south sections.

The convection layer has a thickness of 50 meters or more at the northwestern station and reaches almost 100 meters at station 99. At station 98, which is located

practically at the equator, 0° 18′ north, the thickness is also very great and may perhaps be taken as almost 150 meters. South of the equator the thickness is of the order of 50 meters.

The surface temperatures are above 25° at all stations. The isotherm of 20° runs at approximately the same depth at the northern and southern stations, but rises toward the surface at station 100. The course of the isotherms between stations 102 and 97 is very similar to the course of the corresponding isotherms in Section V between stations 150 and 157. Between the levels of 150 and 300 meters the lowest temperatures occur at station 100, but between 300 and 1500 meters we find the highest temperatures at this station. In still greater depths the temperature maximum shifts toward the south as in Section V. The isotherm of 5° rises more rapidly toward the north than toward the south as was the case in Section V.

The distribution of the salinity is also similar in the two sections, but in Section VIII it is more symmetrical than in Section V. At the surface, values below 34.6 per mille are found between stations 101 and 100. From the region of low surface salinity values we find increasing values both to the northwest and the southeast, but the maximum values are found at some distance from the surface. The tongues of maximum salinity at a depth of about 150 meters indicate a transport of water of high salinity toward the equator, whereas the low surface salinities perhaps can be attributed to a transport of water of low salinity away from the region of low salinity to the north of the equator. At intermediate depths we find a layer of low salinity. The salinity minimum is especially well developed to the northwest where the lowest values, less than 34.20 per mille, are found at stations 103 and 104 at a depth of about 600 meters. The salinity increases toward the southeast and the axis of the minimum values rises in the same direction, following more or less the course of the isotherms, but rising more rapidly than the latter. The temperature at the level of the salinity minimum, therefore, is between 6° and 7° at station 104, but about 8° between stations 101 and 102. Between stations 100 and 101, the layer of minimum salinity appears to diverge in two branches, one which penetrates almost to the surface at station 100, and one which is directed downward. This divergence is not very clearly seen in this section but appears better when the stations are plotted as if they were lying on a north and south line (figs. 32 and 33). A corresponding divergence was much more pronounced in Section V. To the southeast we find minimum values of the salinity of between 34.40 and 34.50 per mille at stations 94 to 97. The minimum is not sharp and the axis of the lowest values, therefore, cannot be determined with any great accuracy. It appears to lie at a level of about 800 meters, and follows the isotherm of 5°. At stations 159 and 162 (Section V) the minimum salinity was found at nearly the same level and the temperature was again approximately 5°.

The salinity distribution which is shown in this section agrees well with the section which Wüst (1929) has constructed for a region farther west, mainly by means of observations on the Planet. Wüst's section extends from latitude 15° north to 35° south, and shows especially that the current, which at a depth of 150 to 200 meters carries water of high salinity toward the equator, submerges between latitudes 25° and 30°. Wüst's section reaches to a depth of 600 meters only. Between latitudes 15° and 10° north the layer of minimum salinity rises from 500 meters to about 350 meters and to the south of 10° north it divides into one ascending and one descending branch in agreement with what we have found. The salinity minimum to the south of the equator is not shown in Wüst's section because it lies at a greater depth.

The deep water, as usual, is very uniform. The temperature decreases to the greatest depth from which observations are available, approximately 3000 meters, and at this level is highest in the southeastern part of the section. The salinity is, on the whole, higher than 34.60 per mille below a level of about 1700 meters and increases with depth as far as the observations go.

Section XIII.--Section XIII (stations 101 to 107) includes stations 101 to 104, which were used in Section VIII, and runs mainly in an east and west direction between longitudes 178° and 146° east. The section forms a regular curves toward stations 101 and 107, however, lying in latitudes 13° 23′ and 14° 05′ north, respectively, whereas station 104 lies in latitude 20° 12′ north. This curvature toward the north, as presently will be seen, determines the characteristic vertical distribution of temperature and salinity which appears in the section.

The convection layer reaches to at least 50 meters at all stations and at some of them has a thickness which probably approaches 100 meters. The temperature section shows the greatest accumulation of warm water in the central part of the section, but this circumstance must be attributed to the fact that the central part lies in a higher latitude than the eastern and western parts. The downward curvature of the isotherm of 10° is, therefore, not related to a change in an east and west direction but to a change in a north and south direction. The isotherms of 5° and less, on the other hand, have their highest position in the central part of the section and the curvature of these isotherms must be related to to the fact that at greater depths the temperature increases from north to south.

The courses of the isohalines show a vertical distribution of the salinity, which agrees perfectly with the vertical distribution of temperature. The highest surface value of the salinity is found at the most northern station, 104. Below the surface on both sides of this station we find a layer of higher salinity which must be related to the subsurface transport of water of high salinity toward the equator. The intermediate salinity minimum is most pronounced and is found at the greatest depth at station 104. The axis of the minimum values rises to both sides, and the values themselves increase. The axis rises more toward the southeast and southwest than do the isotherms. In the central part the axis lies at a depth of 650 meters where the temperature is 6°, but at the most southeastern station the minimum is found at 450 meters where the temperature is 8°.5, and at the most southwestern locality the minimum lies at 400 meters where the temperature is 9°. The only conclusion which can be drawn as to variations in an east and west direction, however, is that the salinity minimum layer appears to lie higher and the temperature is higher at the most western station--107--than at the most eastern station--101.

It is of interest in this connection to point out that at station 149 (Section V), which lies in almost the same latitude as station 104, we found a salinity minimum at a depth of 350 meters where the temperature was 9°. When discussing sections XIV and XV it was shown that the minimum layer apparently sinks toward the west and

this conclusion appears to be verified when one compares conditions at stations 104 and 149.

The deep water is again of a uniform character. The temperature decreases and the salinity increases with increasing depth as far down as observations have been carried out.

Section IX.--Section IX, comprising stations 107 to 120, is actually composed of two different sections, one running southwest from latitude 47° 02′ north and longitude 166° 20′ east to the coast of Japan off Yokohama, and one running north and south following practically the meridian of 144° east between latitudes 35° and 14° north. We shall discuss the latter part of the section first.

The convection layer has a thickness of about 50 meters at the southern stations of the section, but at the northern stations it has a thickness of less than 40 meters.

Temperatures above 25° are found at the three southern stations only, but the isotherm of 10°, except for some undulations, runs almost horizontally at a level of approximately 500 meters, but between the two most southerly stations it rises distinctly toward the south. In this most westerly section we thus find the greatest accumulation of warm water in the upper layers, but in the deeper layers the temperatures are higher at the southern stations. Between 500 and 1000 meters the isotherms diverge toward the south.

The surface salinity has values above 35.00 per mille between stations 108 and 109 only. Values above 35.1 per mille are found between 150 and 200 meters in the most southern part of the section, indicating a transport of water of high salinity from the surface region of high salinity located to the northeast. At a depth of about 500 meters the isohaline of 34.2 per mille runs almost horizontally, undulating up and down, and corresponding to the course of the isotherm of 10°. A conspicuous rise toward the south is found between stations 107 and 108 corresponding to the rise of the isotherms between these stations. The layer of minimum salinity can be followed at all stations to the south of station 113. Between stations 109 and 113 the axis of the minimum value lies at a level of 650 meters where the temperature is about 6° and rises to 8°.5 at a depth of 450 meters at station 107 to the south of station 109. Comparing these conditions with the corresponding conditions in Section VII in the same latitude, we find that the layer of minimum salinity probably lies somewhat deeper in the most western part of the ocean.

In the deep water the temperature, which decreases very slowly toward the north, decreases with increasing depth; and the salinity, which below a level of about 2000 meters is slightly above 34.6 per mille, increases with depth.

In the northeastern part of Section IX we find a quite different stratification. The convection layer is very thin, especially at the northeastern stations where it perhaps has a thickness of 10 meters only.

The most conspicuous feature of the vertical distribution of temperature is the very rapid change in the character of the temperature distribution between stations 112 and 116. The isotherms rise rapidly toward the north in a manner which reminds one of the rise of the isotherms toward the north on the southern side of the Grand Banks of Newfoundland in the Atlantic. Between stations 115 and 116 we find a "cold wall." The change in the temperature distribution, however, appears to be of an irregular character and from the course of the isotherms, it seems that whirls are formed along the boundary between the warm water to the south and the cold water to the north. The great temperature contrasts are present down to a level of 500 meters. Below this level the contrasts gradually get smaller and at 1000 meters the temperature difference has been reduced to 1°. At 2000 meters practically nothing is left.

Between stations 112 and 116 the salinity decreases as rapidly as the temperature. The great irregularities in the distribution of the salinity strongly support the opinion that whirls of great dimensions are formed at the boundary between the warm water of high salinity to the south and the cold water of low salinity to the north. The lowest surface salinities are found at the most northeastern stations 119 and 120 where the values are below 33.00 per mille.

The great contrast between the salinities of the upper layers can be followed to a depth of about 500 meters, but below this level it almost disappears. It is of interest in this connection to note that to the north of station 116 the isohaline of 34.00 per mille lies at a level of approximately 400 meters where the temperature is somewhat above or somewhat below 4°. It also is of interest to note that a downward transport of water, which has the same character as the intermediate water of low salinity in the southern part of the section, apparently takes place only between stations 115 and 116, and that a downward transport of such water can hardly be traced at the northeastern stations.

The deep water has the same characteristics as in the southern part of the section. Taking the section as a whole, we find a tendency toward decreasing temperature and decreasing salinity as we proceed toward the north at a level of about 2000 meters.

Section XVI.--Section XVI (stations 118 to 125) runs west-southwest from latitude 51° 58′ north and longitude 150° 39′ east to 42° 29′ north and 155° 24′ west. In the eastern part the section bends slightly toward the north. On a short stretch it runs along the Aleutian Islands and continues at last in a southwesterly direction. The convection layer is very thin at all stations, especially in the western part of the section where it is of the order of 10 meters only.

Below the topmost surface layer we find between stations 119 and 123 a layer of minimum temperature at a level of about 100 meters. At stations 119 and 120 the temperature within this layer is below 2° and farther to the east values smaller than 3° are found. This water of very low temperature probably comes from the Bering Sea where it has been formed in the preceding winter and from where it has entered the Pacific Ocean, and partly spread toward the east. At greater depths the temperature decreased regularly as far down as the observations were made

The salinity is very low at the surface and increases with depth at all stations except at station 118 where some irregularities are found above 200 meters. The increase of the salinity is especially rapid down to the 200-meter level. From there the increase continues at a slow rate and the value 34°.6 is reached somewhat below the 2000-meter level.

It should be pointed out especially that in this section we find no layer of minimum salinity. Furthermore, we find no water masses which have the characteristic temperature and salinity of the intermediate water in the southern sections, namely, 6° and 34 per mille. The

water which has a salinity of 34.00 per mille has a temperature of about 3°, and water having a temperature of 6° has a salinity which is smaller than 33.5 per mille.

The deep water is again of a uniform character, but appears to be somewhat cooler than the deep water at corresponding depths in the equatorial region. Thus the isotherm of 2° lies at a depth of about 1700 meters in Section XVI, but at the equator it lies at a depth of about 2300 meters. The salinity of the deep water appears to be smaller than in the most northern region; the depth of the isohaline, 34.6 per mille, is about 2300 meters in Section XVI, but at the equator it is about 1600 meters.

Distribution of Density

The horizontal and vertical distributions of density, t, have been represented in figures 234 to 245; I-B and 96, 102, 108, 114, 120, 129, 135, 144, 150, 156, 162, 168, 174, 180, 189, and 198; I-B, respectively. When preparing these the course of the isotherms and isohalines was taken into account. We shall not enter into details but only draw attention to the most prominent features.

When examining the figures showing the horizontal distribution, it should be borne in mind that at any level the movement of the water, relative to the directly underlying water, takes place in such a direction that in the Northern Hemisphere one has the light water on the right-hand side, and in the Southern Hemisphere the light water on the left-hand side.

Surface.--Here we find the lowest densities on both sides of the equator in low latitudes. The belts of low density are separated from each other by a region of higher density where, however, the values are only a little above the values to the north and to the south. To the north of the region of low density in the Northern Hemisphere the density increases rapidly with increasing latitude. This increase is regular except in the region off the coast of California and at the coast of Japan. In the Southern Hemisphere the density appears to increase toward the coast of South America and toward the south, but within a great area off the coast of South America the density remains practically constant. Along the coast of Central America the surface density is very small within a limited region.

One hundred-meter level.--At this level the region with minimum density to the north of the equator partly has been replaced by a region of very high density. To the north of latitude 20° north the density increases toward the north except in the region off the coast of California where a rapid increase toward the coast takes place, whereas the densities are low off the southern coast of Japan. In the Southern Hemisphere the increase toward the coast of South America and toward the south are the most conspicuous features. The low densities along the coast of Central America have disappeared.

Two hundred-meter level.--Here the development has continued in the same direction. The region of maximum density to the north of the equator, however, is less pronounced but stretches across the ocean. Two regions of minimum density are under development in latitudes 20° north and 17° south, and from the former there is a general increase toward the north and toward the coast of California. The low densities off the southern coast of Japan are still conspicuous. In the Southern Hemisphere the increase of density toward the south is more prominent than the increase toward the coast of South America.

Three hundred-meter level.--Here the high densities in the equatorial region show a stripe-like distribution. The density minimum in latitude 20° north is the dominant feature in the Northern Hemisphere. A corresponding minimum is probably developed in the same latitude in the Southern Hemisphere, but the observations are not extended over a sufficiently wide area to show the entire minimum.

Four hundred- and five hundred-meter levels.--At these levels we find practically the same distribution as at the 300-meter level. An area of high density covers the equatorial region to almost 20° south and 20° north, and the stripe-like distribution is still seen. In the Northern Hemisphere the minimum is being displaced more and more toward the north. At these levels and at the 300-meter level the low density off the southern coast of Japan still prevails.

Seven hundred-meter level.--Here the distribution in the Northern Hemisphere is the same as before, except that the minimum has shifted farther north, but in the Southern Hemisphere we find a decrease of the density toward the south at the most southerly stations. At these stations the direction of the relative current thus seems to be reversed. Above the 700-meter level the relative current is directed toward the coast; below the 700-meter level it appears to be directed away from the coast.

One thousand-meter level.--The differences in density have decreased regularly downward and at this level are very small, but in the Northern Hemisphere the distribution has remained more or less unaltered. In the Southern Hemisphere the decrease of the density toward the south at the most southern stations is more pronounced than at the 700-meter level. In latitude 20° south we find increasing density toward the south, whereas at the higher levels we found decreasing densities. The relative current, which at the higher levels was directed toward the west, appears at this level to be directed toward the east.

Fifteen hundred-meter level.--Here the differences in density are very small between latitudes 40° south and and 40° north, but to the north of 40° north we find, even at this level, an increase toward the north. This indicates a relative movement toward the east as in the upper layers. At the southern stations off South America, on the other hand, we still find a decrease toward the south, which indicates relative movement toward the west.

Two thousand-, twenty-five hundred-, and three thousand-meter levels.--Here the density is nearly constant but the values appear to be lower in the Northern than in the Southern Hemisphere.

We shall not enter on a discussion of the distribution of the density in the vertical sections because such a discussion would not add materially to the knowledge of the character of the different water masses which has been obtained by a discussion of the distribution of temperature and salinity.

Temperature-Salinity (tS) Relation

The temperature-salinity diagrams for each station in the Pacific are shown in figures 203 to 209; I-B. We shall not enter on any detailed discussion of the characteristic features of these diagrams at the single stations but shall make use of the tS relation in order to point out the characteristic properties of the water at different levels and in different regions.

For this purpose we have plotted in figures 13 to 18 all observations below the 100-meter level, using vertical lines to designate the observations between 100 and 500 meters, 500 and 1500 meters, and below 1500 meters. The observations have been combined into groups which show the characteristic tS relation within certain regions. The limits of these regions have been determined by means of the tS curves and may thus be regarded as natural subdivisions. Within each region we find, on the whole, the same tS relation at the different stations, and in most cases the transition from one type of tS relation to another is quite distinct. Cases exist in which the transition from one region to another, however, takes place within an area which is so great that observations at some stations show a tS relation which lies between the characteristic relations of the two neighboring regions.

The areas within which the tS relation is nearly the same have been indicated in figure 19 in which they have been numbered from 1 to 14. Figure 20 shows the tS curves for each of these regions. The numbers of the regions are entered on the corresponding curves. The curves represent the mean curves as derived from the diagrams in figures 13 to 18 in which the single observations have been entered. From these single diagrams it is seen that within every region the water is typically stratified. Water of a low temperature is found at great depths only, water of a temperature about 3° to 7° between the levels 500 and 1500 meters, and water of a high temperature is found above 500 meters. It is possible, therefore, even on the average curve, to indicate the depth interval at which water of certain characteristic temperature and salinity is found. This has been accomplished in the average curves on figure 20 by drawing the tS curve which shows the characteristic relation below a depth of 1500 meters as a very heavy line, the curve between 500 and 1500 meters as a moderately thick line, and the curve above 500 meters as a thin line. The moderately thick line represents water which is found between 500 and 1500 meters only, but on the thin line a mark has been placed, indicating the maximum stretch along the tS curve which represents water below the 500-meter level. The part of the thin curve to the right of the mark thus represents water which never is found below 500 meters, whereas the part of the thin curve to the left of the mark represents water which may be found both above and below the 500-meter level.

It is not necessary to enter on the characteristic properties of the water below 1500 meters within the deep areas, because the water is evidently of nearly the same character within all areas. From the course of the tS curve it is evident that the deep water of the lowest temperature has the highest salinity, and also that the salinity of water of a temperature of 2° decreases from the south toward the north. Distinct differences bebetween the different areas are found above the 1500-meter level and we shall discuss these more fully.

Region 1 comprises the most southern area of the Pacific which was investigated, and lies to the west of the South American coast. In this area we find a salinity minimum within the interval 500 to 1500 meters which is characterized by the corresponding values, $S = 34.25$ per mille, $t = 5.^\circ 2$. Above 500 meters we find that water of a high temperature has a lower salinity than is found at any depth below 500 meters.

Region 2 lies to the north and northwest of Region 1 and differs mainly as to the character of the water above 500 meters. The water between 500 and 1500 meters is practically of the same character as in the more southern region, but both salinity and temperature appear to have increased. The corresponding values at the salinity minimum are $S = 34.29$ per mille and $t = 5.^\circ 5$.

Regions 3, 4, and 5 lie between south latitudes 10° and 20°: Region 3 off the coast of South America, Region 4 between longitudes 95° and 130° west, and Region 5 between longitudes 130° and 175° west. Region 5 extends slightly more toward the north than does Region 4. In these three regions we find practically the same tS relation in the interval, 500 to 1500 meters. The corresponding values at the salinity minimum are: in Region 3 $S = 34.51$ per mille, $t = 5.^\circ 6$; in Region 4 $S = 34.52$ per mille, $t = 5.^\circ 6$; and in Region 5 $S = 34.40$ per mille, $t = 6.^\circ 0$. Above the 500-meter level considerable differences exist between these three regions, but we have already dealt sufficiently with these differences when describing the horizontal and vertical distribution of temperature and salinity.

Regions 6 and 7 comprise equatorial areas; one, Region 6, off the South American coast, and the other, Region 7, in the central part of the Pacific. Below a depth of 100 meters we find practically the same tS relation at stations 150 to 158 and stations 98 to 100 and these have, therefore, been combined. It should be noted that the northern limit of Region 7, however, does not run east and west but approaches the equator more in the western than in the eastern part of the ocean. The tS relation below the 500-meter level is similar within regions 6 and 7, the only difference being that in Region 6 higher temperatures are found at 1500 meters. The lowest salinity values between 500 and 1500 meters are about 34.55 per mille and the corresponding temperature is $5.^\circ 6$.

Regions 8 and 9 stretch together across the Pacific in a direction from east-northeast to west-southwest. Within these regions we find some differences between the tS relation in the eastern and western parts of the ocean, but the general features of the relation are similar. In the eastern part the salinity decreases more rapidly with decreasing temperature and reaches a minimum values of 33.98 per mille where the temperature is 8°, but in the western part the decrease of the salinity is slower and a minimum value of 34.23 per mille is reached where the temperature is $9.^\circ 5$.

Regions 10 and 11 to the north of regions 8 and 9 show a similar difference between the relations in the eastern and western parts of the ocean. In the eastern part the salinity decreases rapidly to a minimum of 33.97 per mille where the temperature is 6°, whereas in the western part a more gradual decrease takes place, reaching to a minimum of 34.10 per mille at a temperature of $6.^\circ 5$.

Region 12 lies off the coast of North America and northeast of Region 11. In this region the salinity decreases constantly with decreasing temperature, but the decrease is slow where the salinity has a value of 33.98 per mille and the temperature is 6°, corresponding to the characteristic temperature and salinity at the minimum on the tS curve in Region 11.

In Region 13, which lies off the coast of Japan in latitude 40°, and in which only the three stations--115, 116, and 117--were occupied, we find a tS relation which is rather similar to the relation in regions 10 and 11, but with greater variations. The salinity decreases rapidly with decreasing temperature to a minimum of 33.78 per

mille at a temperature of 5°3 and at greater depths increases with decreasing temperature. The minimum value is found above the 400-meter level, and the corresponding values of temperature and salinity are both lower than the corresponding values in Region 11, but there they are found below 500 meters.

In Region 14 to the south of the Aleutian Islands and the Bering Sea we find increasing temperature with decreasing salinity up to 500 meters, but above this level the temperature remains constant at about 3°4, whereas the salinity decreases.

It is seen that the tS curves in regions 1 and 2 and regions 10 and 11 have nearly the same form except in Region 1 near the surface. The stratification is thus of a similar character in the North and South Pacific. The transition from the tS curve in about latitudes 40° south and 40° north to the tS curves of the equatorial region is more or less similar in both hemispheres.

The Intermediate Water

The most conspicuous feature which is revealed by the curves is the existence of water of low salinity at an intermediate depth. In the Southern Hemisphere the intermediate water of the Pacific Ocean is probably being formed in the same manner as the corresponding intermediate water of the Atlantic and Indian oceans; it sinks and flows north from the region of the Antarctic convergence, which has been traced all the way around the Antarctic Continent.

If the Antarctic intermediate water follows a more or less direct course from the region where it submerges to the regions in which we have found it, we must assume that the water has a high oxygen content. Fortunately the oxygen content has been observed at two of the Carnegie stations in regions 1 and 2, namely at stations 52 and 57. At station 52 the observations show a maximum of oxygen, 5.09 ml/L, at a depth of 657 meters where the intermediate water was found. At station 57 observations are lacking for the central part of the intermediate water but at the upper part of this water, at a depth of 468 meters, the oxygen content showed a maximum of 5.47 ml/L. Thus, the intermediate water appears to have a high oxygen content in contrast with the corresponding water in the Northern Hemisphere. This high content strongly supports the opinion that the water comes on a direct route from a region where it has been in contact with the atmosphere.

In the Northern Hemisphere a convergence, corresponding to the Antarctic convergence, is not found, but we have seen, when studying Section IX, that big whirls are formed along the boundary of the warm and the cold water off the Japanese coast, and it was pointed out that within these whirls water of the typical properties of the intermediate water was found. In this region probably we must look for one of the places where a supply of water to the intermediate current takes place. It is possible that the region where such whirls are formed extends to some distance from the Japanese coast, but this extension cannot be very great, considering the general character of the currents. The water which is supplied to the intermediate current should thus be formed by mixing of different water masses in the region off Japan, but this mixing takes place below the surface, judging from the conditions which are represented in Section IX.

The mixing appears to take place between water of low temperature and low salinity coming from the north, perhaps from the upper layers, and warmer water of higher salinity which is carried from the south by subsurface currents. Therefore, part of the water which supplies the intermediate current has not been in direct contact with the atmosphere and must consequently contain a relatively small amount of oxygen. Such processes would explain the fact that the oxygen content of the intermediate water in Region 11 is of the order of between 2 and 4 ml/L. In this region the oxygen content of the intermediate water generally decreases with increasing depth, but a secondary maximum between 300 and 400 meters at stations north of latitude 20° north in indicates an admixture of surface water.

The Deep Water

Temperature and salinity.--When discussing the horizontal and vertical distribution of temperature and salinity, we pointed out that the deep water is of a very uniform character. The temperature lies between 1°5 and 2°, and the corrected salinity between 34.65 and 34.73 per mille. Our horizontal representations went down to a level of 3000 meters. It is of interest to examine the few observations which are available for greater depths. At several stations observations with intervals of about 500 meters were taken below the 3000-meter level. At a great number of stations the temperature at the bottom was measured, but in these cases no water samples were obtained for determining the salinity.

Table 9 gives the mean temperatures and salinities within the regions into which the ocean was divided on the basis of the tS relations. The mean values have been computed for the intervals 3000 to 3500, 3500 to 4000, 4000 to 4500, and below 4500 meters. From the last interval only temperature observations are available, and from the interval 4000 to 4500 meters salinity observations are present from regions 4 and 6 only.

It is seen that the temperature is very uniform in the great depths of the North Pacific where the greatest difference between any of the mean values from the different depths and different regions amounts to only 0°24. The temperature appears to increase slightly toward the bottom within some of the regions and later we shall return to this feature.

In the South Pacific we find, on the other hand, considerable variations both in a horizontal direction and with depth. The highest temperature is found in Region 6 near the equator off the coast of South America and off the coast of Peru where the temperature is constant between 3000 and 4000 meters. In Region 5 in the central part of the Pacific in latitude 15° south and in the most southern region--1--the temperature decreases with increasing depth.

The salinity appears to decrease from the Southern to the Northern Hemisphere but within each region the variations in a vertical direction are so small that they are within the limits of the accuracy of the observations. The values in the table should probably be increased by 0.03 per mille (see p. 72).

Bottom temperature.--The bottom temperatures at depths greater than 3000 meters have been entered in table 10 and figure 21. The values underscored in the figure refer to depths between 3000 and 4000 meters. In the South Pacific high bottom temperatures are found in the eastern part but here no observations from depths

Table 9. Temperatures and salinities below 3000 meters in stated regions and intervals of depth

Depth in meters	Region													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
							Temperature °C							
3000-3500	1.52	1.86	1.82	1.83	1.66	2.09	1.59	1.68	1.55	1.55	1.54	....	....	1.57
3500-4000	1.23	....	1.82	1.57	1.51	....	1.46	....	1.52	1.46	1.51	1.58	....	....
4000-4500	....	....	....	....	1.33	....	....	....	1.55	....	1.53	1.56	....	....
4500	....	....	....	....	1.21	....	1.44	....	1.52	1.49	1.61	....	....	....
							Salinity °/oo *							
3000-3500	34.68	....	34.67	34.67	34.66	34.62	34.66	34.64	34.64	34.62	34.62	....	....	34.63
3500-4000	34.65	....	34.68	....	34.66	....	34.64	....	34.64	34.63	34.65	....	....	....
4000-4500	....	....	....	....	....	....	....	....	34.64	....	34.65	....	....	....

*Values probably 0.03 °/oo too low.

greater than 4000 meters are available. The lowest bottom temperatures are found to the south of the equator at stations 160 and 161 in about latitude 13° and longitude 167°. The values of temperature at these stations are 1°.09 and 1°.08 at the depths 4444 meters and 5084 meters respectively. Between the equator and latitude 20°, and in longitude 140° west, the bottom temperatures lie between 1°.4 and 1°.5, but to the north of latitude 20° we find values above 1°.5 in the entire region except at two stations off the coast of Japan, where lower temperatures are found. At two stations--141 and 142--to the northwest of the Hawaiian Islands, temperatures are above 1°.6, but other than these exceptions the bottom temperatures appear to be very uniform.

When discussing the mean temperatures at different depths and within different regions, we pointed out that the temperature increases with depth in some regions. Examining the data from the single stations, we find only four stations at which a decided increase of temperature with depth takes place, namely, stations 37, 135, 142, and 146.

Table 11 gives the observed temperatures at these stations, the potential temperatures (see p. 32) the salinities, and the oxygen content. Station 37 is located off the coast of Central America, and here the increase of temperature with the depth is so considerable that the potential temperature is constant. The decrease of the salinity from 34.65 per mille (34.68) at 2730 meters to 34.63 per mille (34.66) at 3231 meters is so small that we cannot give any weight to this difference. We must assume that the salinity is constant, and the constant potential temperature then indicates that indifferent equilibrium exists below a level of 2700 meters.

Stations 135, 142, and 146 are all taken in nearly the same region. At these stations the temperature increases with depth, but the potential temperature decreases and at the same depth is very nearly the same at the different stations. The salinity, on the other hand, appears to be constant. The variations must be ascribed to accidental errors of observation because, combining observations from five stations in this region, we find the salinities 34.638 (34.668), 34.650 (34.680), and 34.644 (34.674) per mille at the depths 3100, 3700, and 4100 meters, respectively; that is, practically no variation with depth. The equilibrium must, therefore, be stable. At a few other stations in this same region we find an indication of a temperature minimum at a depth of 3700 meters, but the increase below this level is smaller than 0°.05 and therefore the stratification is still more stable at these stations. Helland-Hansen (1930) has shown that in the eastern North Atlantic the potential temperature is constant below a level of 4000 meters, whereas in the western North Atlantic it decreases toward the bottom.

Table 10. Bottom temperatures of water, bottom depths greater than 3000 meters, Pacific Ocean, Carnegie, 1929

Station	Latitude	Longitude West	Depth		Temperature
			Thermometer	Bottom	
	° ′	° ′			°C
49	23 16 S	114 45	3098	3098	1.86
76	15 18 S	97 28	3181	3197	1.84
82	14 52 S	126 07	3596	3631	1.57
83	17 00 S	129 45	3921	3966	1.55
84	17 11 S	133 18	4076	4121	1.51
85	17 12 S	136 37	3746	3791	1.53
87	18 05 S	145 33	4270	4315	1.40
110	26 20 N	215 36	2996	3036	1.49
111	31 00 N	215 44	5978	6008	1.49
112	33 51 N	218 45	3901	3931	1.41
115	37 40 N	214 34	5360	5396	1.55
116	38 41 N	212 19	5513	5545	1.53
117	40 20 N	209 02	5261	5296	1.56
119	45 24 N	200 24	5170	5198	1.54
127	44 16 N	137 37	4004	4026	1.56
128	40 37 N	132 23	3796	3806	1.58
131	33 49 N	126 20	4388	4418	1.55
132	31 38 N	128 48	4221	4251	1.55
133	29 21 N	132 30	4396	4426	1.57
134	27 45 N	135 22	4498	4528	1.58
135	26 39 N	139 07	4660	4695	1.56
137	24 02 N	145 33	5268	5208	1.52
138	22 53 N	151 15	5342	5382	1.52
139	21 47 N	155 31	4990	5030	1.49
140	23 26 N	159 27	4722	4762	1.55
141	29 02 N	161 11	5627	5667	1.63
142	32 42 N	160 44	5747	5787	1.65
146	31 51 N	140 50	4716	4756	1.55
148	24 57 N	137 44	4795	4835	1.50
149	21 18 N	138 36	5280	5320	1.53
150	16 15 N	137 06	4513	4553	1.44
151	12 40 N	137 32	4878	4918	1.49
155	4 51 N	146 46	5273	5304	1.44
156	3 01 N	149 46	4913	4953	1.39
159	9 24 S	159 01	5505	5545	1.34
161	12 04 S	164 57	4444	4484	1.09
162	13 36 S	168 23	5084	5124	1.08

A constant potential temperature over a wide area is generally attributed to the influence of heating from below, from the interior of the earth, and it is assumed that the horizontal currents must be very slow where a constant potential temperature can be developed. Examples of a constant or even a downward increasing potential temperature are known from the deep basins in the region of the East Indian Islands, and here one probably finds stagnating water in the great depths. The fact that the potential temperature appears to decrease toward the bottom in the North Pacific indicates that the bottom water is not stagnating but is being renewed. The relatively high oxygen content and the increase of this content toward the bottom strongly support the opinion that a renewal of the bottom water by horizontal transport takes place. The low bottom temperatures in the South Pacific point toward a more rapid renewal of the bottom water in this part of the Pacific. No oxygen observations are available from these stations and therefore we are unable to obtain a verification of our conclusions.

The origin of the deep water of the Pacific has been discussed previously (Sverdrup, 1931). It was pointed out that the deep water cannot be formed by the sinking of surface water in the central part of the ocean (combined with processes of mixing) because the deep water is separated from the surface water by a layer of minimum salinity. It was also shown that the deep water could not be formed in the neighborhood of the Antarctic Continent because the temperatures are too high. We may add that, for the same reason, the deep water cannot come from the Bering Sea. Furthermore, it is not probable that bottom water of low temperature is formed in the Bering Sea by the processes which have been described by Nansen, because the surface salinities in the Bering Sea appear to be too low, if we judge from the salinity of the surface current which enters the Pacific Ocean.

The available data strongly point in the direction that water of the same type as the deep water of the Pacific is formed in the eastern part of the Indian Antarctic Ocean and that the origin of the deep water of the Pacific has to be sought there. In order to explain this formation, it was assumed that Antarctic bottom water

Table 11. Stations at which a decided temperature increase toward the bottom was observed.

Station	Depth		Temperature		Salinity* ‰	Oxygen content ml/L
	Bottom meters	Obs'n. meters	Obs'd. °C	Poten. °C		
37	3324	2730	2.05	1.84	34.65	.....
		3231	2.10	1.84	34.63	.....
		3324	2.12	1.85	....	.....
135	4695	3301	1.52	1.26	34.64	2.92
		3736	1.51	1.21	34.65	3.11
		4098	1.53	1.19	34.63	3.15
		4660	1.56	1.15	....	.....
142	5787	3268	1.54	1.28	34.60	2.83
		3682	1.52	1.22	34.64	3.23
		4043	1.53	1.19	34.62	3.29
		5747	1.65	1.09	....	.....
146	4756	3159	1.54	1.31	34.65	2.23
		3610	1.50	1.21	34.66	3.11
		4069	1.51	1.17	34.65	3.11
		4486	1.55	1.16	34.65	3.40
		4716	1.55	1.13	....	.....

*Values probably 0.03 ‰ too low.

of low temperature and relatively high salinity was formed everywhere on the continental shelf of the Antarctic Continent. This water would sink to great depths and contribute toward the formation of cold bottom water which would tend to spread toward the north but, owing to the rotation of the earth, would be deflected to the left and flow along the continent from east to west. A complete circumpolar flow would, however, not be developed since the submarine ridge between South America and the Antarctic Continent would present a serious obstacle to a flow of the bottom water toward the west. In the region of the Weddell Sea the bottom water, therefore, would be deflected toward the north and a great part of this water would enter the western basin of the South Atlantic Ocean. Furthermore, it was assumed that this inflow of cold bottom water was in part responsible for the outflow from the Atlantic of warmer and more saline deep water at some higher level. This flow of Atlantic deep water must also be deflected toward the left which, in this case, means to the east, and the Atlantic deep water must, therefore, enter the Indian Ocean as pointed out by L. Möller (1929) and clearly demonstrated by Wüst (1935). In the Antarctic Ocean to the south of the Atlantic and the Indian oceans, mixing between these two types of water, the cold Antarctic bottom water and the warmer Atlantic deep water, must take place and, as a result of these processes of mixing, a water type is formed which is similar to the deep water of the Pacific. It was assumed that this water enters the Pacific through the passage between New Zealand and the Antarctic Continent.

This hypothesis concerning the formation of the deep water of the Pacific was advanced at a time when no reliable deep-sea observations were available from the vicinity of the Antarctic Continent except in the Weddell Sea area. Since that time a considerable amount of oceanographic work has been carried out on the expeditions with Discovery II, on the British Australian New Zealand Antarctic expeditions conducted by Sir Douglas Mawson, and on the Norwegian expeditions organized by Mr. L. Christensen. The observations from these various expeditions have not yet been published,[1] but the writer has had opportunity to examine the results from the British Australian New Zealand Antarctic expedition and to become acquainted with results from L. Christensen's cruises. The new information necessitates considerable modification of the views which were presented in 1931 but the most important conclusion, that the deep water of the Pacific Ocean is formed in the Antarctic Ocean and enters through the passage between New Zealand and the Antarctic Continent, remains unaltered.

It is now evident that a considerable formation of Antarctic bottom water takes place only within the area of the Weddell Sea. H. Mosby (1934) has shown that the bottom water in the Weddell Sea is formed by mixing of deep water (temperature about 1° C and salinity about 34.70 per mille) and water from the continental shelf which has been cooled to freezing point (about -1.°85 C) and which has attained a salinity of about 34.60 per mille, owing to the processes of freezing. The resulting bottom water has a temperature of about -0.°6 C and

[1]The observations in physical oceanography in the British Australian New Zealand Antarctic expedition have been published by A. Howard (1940) and have been discussed by H. U. Sverdrup (1940).

a salinity of about 34.66 per mille, and it shows a high oxygen content since the water on the shelf is nearly saturated with oxygen. Along the Antarctic coast of the Weddell Sea the flow of the water is directed toward the west and the westward motion of the waters can be traced as far east as the region of Enderby Land. This westward flow represents the southern part of a big eddy which characterizes the entire Weddell Sea region.

The observations from the Australian Antarctic expeditions and from L. Christensen's expedition with the Thorshavn show that sinking of water from the continental shelf does not contribute materially to formation of bottom water within the entire region from Enderby Land and eastward to Drake Passage and they show, furthermore, that the flow of the deep water is directed toward the east within the entire region. From observations at a few stations it is evident that water from the shelf intermittently sinks to great depths but in small quantities only, for which reason the character of the bottom water is only slightly influenced by these processes. The previous hypothesis of the writer, that bottom water was formed all around the Antarctic Continent and that a flow of bottom water toward the west took place in every region, must therefore be abandoned. It is probable that the surface waters near the continent flow toward the west, but within the deep water there evidently exists an Antarctic circumpolar current which flows toward the east and follows the continent (except in the region of the Weddell Sea) as far east as Enderby Land, where a big eddy occurs on the southern side of the circumpolar current.

The characteristic properties of the water masses within this circumpolar current are mainly determined by the deep-water flow in the Atlantic Ocean, including the Weddell Sea area. The deep-water flow within the Atlantic Ocean has recently been discussed by Wüst (1935) who has shown that three areas exist within which the surface waters attain such a high density that they must sink and contribute to the renewal of characteristic water masses at great depths. One of these areas is represented by the Mediterranean. Water of very high salinity flowing out from the Mediterranean mixes with Atlantic water and spreads toward the north and the south, where it can be traced as an upper deep water. A second area is found in the waters between Iceland, Greenland, and Labrador. Within this area Atlantic water of relatively high salinity is mixed with Arctic water and cooled to such a low temperature that in some localities water is formed which is of uniform density from the upper layers to the bottom. Here water from the upper layers may sink to great depth and contribute to the renewal of the Atlantic lower deep water (mittleres Tiefenwasser, according to Wüst's terminology) which can be traced to latitude 55° south. Within this region or farther north, conditions may favor the development of a water of lower temperature and lead to formation of the bottom water of the North Atlantic, but this type of water does not spread to any considerable distance and is, therefore, of minor importance. The third area is within the Weddell Sea, where the Antarctic bottom water is being formed in the manner which has been described. This bottom water spreads toward the north and can be traced to latitude 40° north.

Within the Atlantic Ocean we find, therefore, an "active" deep-water circulation, especially between the sea to the south of Greenland where the Atlantic lower deep water is formed, and the area of the Weddell Sea where the Antarctic bottom water originates. No such "active" deep water circulation is present in the other oceans. In the Indian Ocean water from the Red Sea spreads at moderate depths, but is of much less importance than the Mediterranean water in the Atlantic. Water corresponding to the Atlantic lower deep water is not formed in the Indian Ocean nor is Antarctic bottom water formed south of the Indian Ocean. Within the entire area of the Pacific Ocean no renewal of any type of deep water takes place.

The water masses of the Antarctic circumpolar current are, as already mentioned, formed by mixing of Atlantic deep water and Antarctic bottom water. Wüst has shown that such processes of mixing take place to a great extent in the Atlantic Ocean, and he has computed the percentage amount of true Atlantic deep water or true Antarctic bottom water in the layers of the Atlantic Ocean. The two types of water are still characteristically different within the circumpolar current in the southern part of the Atlantic Ocean, but when carried toward the east by this current the differences disappear, owing to processes of mixing, and to the south of Australia we find water of a very homogeneous character which can be described as a special type of water, the Antarctic circumpolar water. The temperature of this water lies between 0° and 2° and the salinity between 34.68 and 34.74 per mille.

This water flows, as already stated, around the entire Antarctic Continent and follows the continental slope except in the region of the Weddell Sea where there is a large eddy south of the circumpolar current. This is evident from the observations of the Australian Antarctic expedition, and Clowes (1933) has convincingly shown that the flow through Drake Passage is directed from the Pacific to the Atlantic Ocean. Accurate determinations of the oxygen content within the circumpolar current might confirm this conclusion. From the Meteor observations (in 1926) Wüst finds in the Weddell Sea region an oxygen content of 4.6 ml/L at a temperature of 1.°6, and of 5.6 ml/L at a temperature of -0.°6. The oxygen observations on the Australian Antarctic expedition and L. Christensen's expedition with Thorshavn, and observations from the Drake Passage on board Discovery II in 1931 indicate a decrease of the oxygen content of the deep water from the region north of the Weddell Sea and eastward to Drake Passage. Within the Antarctic circumpolar water, the oxygen content increases toward the bottom and the temperature decreases. Thus, a relation exists between the oxygen content and the temperature and, on an average, the oxygen content is nearly a linear function of the temperature.

In the Weddell Sea region (1926)

$$O_2 = [4.42 + 0.45(2^\circ - t)]\,\mathrm{ml/L}$$

In the Indian Antarctic Ocean (1929-1930)

$$O_2 = [4.18 + 0.50(2^\circ - t)]\,\mathrm{ml/L}$$

In the Drake Passage (1931)

$$O_2 = [3.95 + 0.45(2^\circ - t)]\,\mathrm{ml/L}$$

The Meteor observations in the Drake Passage in 1926, however, show very nearly the same oxygen content as the water of similar temperature and salinity to the north of the Weddell Sea.

Drake Passage (1926) $O_2 = [4.35 + 0.45(2^\circ - t)]\,\mathrm{ml/L}$

Thus, the evidence is conflicting and at present it can only be stated that a majority of observations indicate a decrease of the oxygen content of the deep water in an

eastward direction from the Weddell Sea to the Drake Passage, as would be expected if the flow is directed to the east, but this feature needs to be confirmed. It may be added that great variations may occur, owing to variations in the admixture of water from the shelf, and such variations may be responsible for the different conditions in different years.

The deep water of the Pacific is, as already stated, similar to the deep water of the Antarctic circumpolar current, which is characterized by temperature between 0° and 2°, and by salinity between 34.68 and 34.74 per mille. From table 9 it is seen that below 3000 meters the temperature lies between 1°.2 and 1°.9, if we disregard Region 6 off Central America. The observed salinity lies between the limits 34.62 and 34.68 per mille, but the values are probably consistently about 0.03 per mille too low, and the actual range is therefore 34.65 to 34.71 per mille, in good agreement with the salinity of the circumpolar waters. The highest salinities (corrected values greater than 34.7) are found in the South Pacific where, according to the few available data, the oxygen content of the deep water appears to be relatively high. These features indicate that the deep water of the South Pacific is slowly renewed by addition of water from the circumpolar current. Whether this renewal has the character of the regular inflow in some definite region or takes place by irregular processes of mixture cannot be decided by means of the available data.

In the North Pacific the salinity of the deep water is slightly lower, and the oxygen content considerably lower. These features indicate that the renewal of the deep water of the North Pacific by admixture of water from the Antarctic region is much slower than in the South Pacific, and, furthermore, it must be assumed that slow admixture of intermediate water of low salinity takes place and reduces the salt content of the deep water.

The information which is now available strongly points in the direction that no definite flow of deep water exists in the Pacific Ocean and that the renewal of the water is a result of slow and irregular processes of mixing. It cannot be doubted, however, that on an average a transport of deep water takes place from south to north. It is possible that this transport takes place principally along the bottom, and that an outflow of deep water from the Pacific is present at some high level. It is also possible that the outflow from the Pacific takes place within the upper layers and that slow descending motion of the deep water occurs in certain regions.

Currents

Surface Currents

On several occasions we have touched on the problem of the circulation of the waters in the Pacific and especially have discussed to some extent the intermediate currents in the South and the North Pacific. We shall now undertake a more detailed discussion of the circulation as far as this is possible by means of the Carnegie data. The discussion will be based principally on the charts showing the topography of the isobaric surfaces 0, 100, 200, 300, 400, 500, 700, 1000, and 1500 decibars relative to the topography of the 2000-decibar surface. In these charts, lines of equal relative elevation have been drawn, except off the coast of Japan where the conditions are too complicated to be represented by the few observations of the Carnegie in this region. Near the equator the course of the lines is also very doubtful for reasons which will be explained when dealing with the Equatorial Countercurrent.

The charts represent very nearly the absolute topography of the different isobaric surfaces because it can be assumed, on account of the uniform character of the deep water, that the 2000-decibar surface is very nearly horizontal. It must be borne in mind, however, that when constructing the charts we combined the data from stations which in some regions were taken at great intervals of time. This combination may lead to apparent irregularities, especially in regions where the current systems undergo considerable displacement. Furthermore, it must be emphasized that from our representations we can draw conclusions only as to the currents which are maintained by the distribution of density. The distribution of density is partly maintained by the processes of heating and cooling, evaporation and precipitation, and partly by the effect of the prevailing winds on the surface layers.

It is clear that differences in heating and cooling in the different latitudes, and differences in evaporation and precipitation, create differences in density which maintain a system of currents independently of the action of external forces such as the tangential force exerted by the prevailing wind. On the other hand, it is not self-evident that the prevailing winds influence the distribution of density in such a manner that part of the effect of the winds is included in the currents which are computed on the basis of the distribution of density, but some evidence that such is the case can be found.

Figure 22 shows the currents at the surface, supposing the water at a depth of about 2000 meters to be at rest, and supposing that the velocity, v, of the currents can be derived from the map representing the topography of the surface by means of the formula

$$v = (1/L)(c/\sin \phi)$$

where L is the distance between two lines of equal dynamic height (anomaly), and ϕ is the geographic latitude, and c is a constant. The current is directed at right angles to the gradient of the isobaric surface, that is, parallel to the lines of equal dynamic height. In the Northern Hemisphere it is directed 90° to the right of the gradient, in the Southern Hemisphere 90° to the left.

This computation probably gives velocities which are too great in the vicinity of the equator because the friction, which is not considered, probably plays a greater part in this region. Aside from these restrictions the computed surface currents represent the currents which result from the distribution of density between the surface and a depth of about 2000 meters.

This map of the surface currents will now be compared with the map of the surface currents (figure 23) constructed by Merz and published by Wüst (1929). The latter map is based on the observed surface currents as obtained by dead reckoning and astronomic observations on board ship, and thus represents the actual currents as resulting from the combined effect of the prevailing winds and the distribution of density. The agreement between the two maps is remarkable, considering the widely differing material on which they are based. Some discrepancies are found in the northern part of the North Pacific, but it may be noted that:

1. The line separating the easterly and westerly currents in the North Pacific in figure 22 lies near the line of subtropic convergence as shown by Merz.

2. The convergence in latitude about 40° north off the coast of Japan in the figure corresponds to the western part of the northern polar front as shown by Merz.

3. The westerly current in the inner part of the Gulf of Alaska is seen in both maps.

4. The Equatorial Countercurrent runs in nearly the same regions on the two maps.

5. The line separating the westerly and easterly currents in the eastern part of the South Pacific practically coincides with the corresponding line of subtropic convergence as shown by Merz.

It is hardly a coincidence that the surface currents, which are derived from dynamic computations, agree with the observed surface currents, in spite of the fact that the latter result from the combined effect of the wind and the primary distribution of density. This agreement must be interpreted as indicating that the effect of the wind is to maintain a certain distribution of density, and the computation of the currents on the basis of the density distribution actually includes part of the effect of the prevailing winds.

Palmén (1930) has recently discussed a number of observations from the Gulf of Bothnia which demonstrate in a striking way the effect of the wind on the distribution of density. When the wind blows in the direction of the Gulf the light water is accumulated along the right-hand shore and the heavy water along the left-hand shore. The current, which is computed from this distribution of density (the convection current according to Ekman's terminology) has a velocity corresponding to the velocity of the wind current which would be produced under the given circumstances. This example deals with conditions in a narrow bay, but it is probable that the results are of general importance and that even in the open ocean we may find that the wind changes the distribution of density in a corresponding manner. This would mean that a prevailing wind maintains an abnormal distribution of density. If the wind should stop blowing, the normal distribution of density would be re-established, and the dynamic computation would give the current which would be present if the tangential force exerted by the wind on the surface were absent. Supposing these considerations to be correct, we may regard our dynamic charts as representing the total currents resulting from the differences in density which would occur in the absence of wind, and from the abnormal distribution of density which is established and maintained by the action of the wind.

As to the character of the wind current we remind the reader of Ekman's theory. According to this the total transport of water is directed 90° to the right of the direction of the wind in the Northern Hemisphere, and 90° to the left in the Southern Hemisphere. The depth to which the wind current reaches depends on the latitude and on the eddy viscosity, which again is a function of the stratification of the water.

In general, it is assumed that at some distance from the equator the wind currents reach to less than 100 meters in depth, but the effect on the distribution of density must reach much deeper. Since the surface water is light, a transport of surface water to the right of the direction of the wind leads to an accumulation of light water on the right-hand side of the wind, and on the left-hand side the light surface water must be replaced by heavier water from greater depths. On the right-hand side of the wind the surfaces of equal density are depressed, and on the left-hand side they are raised. The effect may reach to considerable depths and, owing to this "abnormal" distribution of density, a current in the direction of the wind is created.

In the open ocean the maintenance of an abnormal distribution of density represents only part of the effect of the wind. If it represented the total effect, the condition

$$\left(\nu \frac{dv_x'}{dz}\right)_0 = -T_x, \quad \left(\nu \frac{dv_y'}{dz}\right)_0 = -T_y$$

would have to be fulfilled. Here ν is the coefficient of eddy viscosity, v_x' and v_y', the components of the convection current, and T_x and T_y, the components of the tangential stress of the wind. This condition, which may be satisfied in a narrow channel, is never fulfilled in the open ocean, since a decrease of the required magnitudes of the velocity near the surface does not occur. Pure drift currents will, therefore, be present beside the convection current, but under stationary conditions the climatological factors may balance their effect on the distribution of density. We shall not enter any further on this subject but shall, in the following, consider only the currents which are associated with the distribution of density.

We shall first examine the currents in the troposphere, which extend to a depth of about 500 meters. In the North Pacific the dominant feature is represented by the anticyclonic current system which has its center in latitudes 25° to 30° north, and in longitude about 180°. It is perhaps not correct, however, to use the term "center" because, apparently, we find an axis of maximum elevation of the isobaric surfaces stretching from the region to the south of Japan toward the Hawaiian Islands. On the northern side of this axis we find currents toward the east, and on the southern side currents toward the west or southwest.

A similar current system is probably present on the Southern Hemisphere, but our observations are not extended over a sufficiently wide area to disclose the different branches of this system. In our charts we find the westerly current represented between latitudes 0° and 20° south, although it appears to have a less stable character than the corresponding current in the Northern Hemisphere. The easterly current is seen to the south of latitude 30° south between longitudes 80° and 120° west. Between the tropical westerly currents we find the Equatorial Countercurrent which is in longitude 140° north and latitude 11° north where it runs as a very strong and narrow current, and in longitude 175° west appears as a rather broad and weak current extending to both sides of the equator, but to the greatest distance on the northern side.

It is of advantage to discuss separately the different branches of the current systems in the two hemispheres and we shall, as previously, begin with the most southern part of the South Pacific.

In the southeastern part of the Pacific our charts show the northern branch of the South Pacific east drift. The current runs toward the east between latitudes 30° and 40° south, and can be followed from the surface to a depth of 500 meters, but the velocity decreases downward and is very small below 300 meters. Above a depth of 400 meters the current appears to turn toward the west in latitude 30° south, but below 400 meters a closed circulation appears to be present between longitudes 80° and 120° west.

The greater part of the water masses which are carried to the east does not turn toward the equator until reaching the South American coast, then it follows this coast toward the north as the Peruvian Current. This current can be traced to a depth below 500 meters. We have previously pointed out that water of low temperature is found at a short distance from the surface off the coast of Peru, and that the surface temperatures are very low in this region. It cannot be doubted that these low surface temperatures are owing to a vertical movement which carries water of low temperature to the surface, but the accumulation of cold water off the coast can be explained without taking a possible vertical movement into consideration. We must bear in mind that water is transported toward the coast of South America by the predominating current toward the east. This water is forced to change its course and to continue toward the equator. The Peruvian Current is, thus, a "forced" current which must exist because of the land boundaries of the ocean. In such a current we must find the normal distribution of density, which means that in the Southern Hemisphere we must find water of high density on the right-hand side of the current and water of low density on the left-hand side. Consequently the density must increase toward the coast or, if the salinity is nearly constant, water of low temperature must accumulate along the coast. The accumulation of cold water along the coast of South American gives, therefore, no evidence of an upwelling motion which reaches to great depths, but indicates only that a current follows the coast toward the equator (cf. Helland-Hansen [1912]). On the other hand it is evident because of the conspicuously low surface temperatures, that water from moderate depths is drawn to the surface at the coast. This upwelling from moderate depths is probably maintained by prevailing winds and is a secondary effect as compared with the large accumulation of cold water at greater depths. The actual surface current, which represents the combined effect of the distribution of density and of the wind, probably is directed away from the coast, for which reason the continuity would necessitate a supply of water from below, that is, an upwelling.

As to the direction of the winds which maintain the offshore currents, it should be borne in mind that on account of the effect of the rotation of the earth, the transport of water by wind takes place at right angles to the direction of the wind, to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. The winds, therefore, which approximately parallel the coast toward the equator, give rise to a transport of water having an offshore component.

It is well known that the regions of upwelling are all found at the west coasts of the continents where the wind currents transport water away from the land. The upwelling has, therefore, generally been attributed to the effect of the winds. The present interpretation of the observed conditions does not differ from the accepted explanation of the upwelling, but here it is emphasized that the upwelling water comes from small depths and that the the accumulation of cold water in greater depths is not a result of the upwelling but is associated with the presence of a "forced" current along the coast.

To the north of latitude 20° south we find, on the whole, currents which are directed toward the west. Here we have the region of the westerly tropical current in the South Pacific. This westerly current appears to be very irregular. In the region from the coast of Peru to longitude 120° west it appears as if divergent currents are found to a depth of about 100 meters. These diverging currents may be an effect of the prevailing east winds which carry the surface water to the north on the northern side of the equator and to the south on the southern side. If this is correct, we must assume that ascending motion takes place in the region to the south and the west of the Galapagos Islands, and such currents would account for the low surface temperature of this region. The high phosphate content of the surface water in this region supports such a conception. Below a depth of 200 meters water from the northwest appears to flow toward this region, perhaps compensating for the water which is drawn to the surface. Farther west, between longitudes 120° and 170° west, we find that the currents have considerable components from the south down to a depth of about 200 meters. In this region, at a depth of between 100 and 200 meters, the southern part of Section V indicates a considerable northward flow of water of high salinity. The dynamic charts confirm that such a flow takes place above the 200-meter level because the northerly component of the current is greatest down to this level. The irregularities in the topography of the isobaric surfaces perhaps indicate that the flow toward the equator of water of high salinity does not take place continuously but has an intermittent character. The fact that the irregularities are especially present above the 200-meter level points in this direction. An intermittent transport of water toward the equator means that whirls develop within which subsurface water may be transported to the surface. At several stations in this this region water of high phosphate content and low oxygen content is found, indicating that such transport takes place.

Before concluding the discussion of the westerly tropical current, we shall emphasize that this current, aside from the wind current at the surface, dynamically is partly of the same character as the Peruvian Current. The water, which is transported toward the South American coast by the easterly current in the South Pacific and is forced toward the equator along the continent, cannot sink because of its low density and must return toward the west as a surface current within which the easterly winds carry the light water to the south. The westerly tropical current is thus in part maintained by the same forces which maintain the easterly current in the southern part of the ocean and in part by the prevailing winds. In the Southern Hemisphere we find water of low density on the left-hand side of the current and water of high density on the right-hand side; that is, an accumulation of heavy water under the equator and an accumulation of light water to the south of the westerly current. This distribution of density must be regarded as a "forced" distribution owing to the limitation of the ocean in an east and west direction and to the effect of the prevailing winds.

To the north of the equator a corresponding current is found, the westerly tropical current of the North Pacific. Observations are lacking for a great part of the North Pacific between the coast of Central America and longitude 130° west and our picture, therefore, is incomplete. It appears, nevertheless, as if the form of the North American Continent is of considerable importance to the development of the currents. We shall deal further with this subject when discussing the California Current.

The westerly tropical current in the North Pacific

appears to be stronger and more regularly developed than the corresponding current in the Southern Hemisphere. The former current must also be regarded as a forced current which is maintained partly by the prevailing winds and partly by the factors driving the easterly current of the northern part of the ocean, namely, the differences in density between the subtropical and the subarctic water. Since the North Pacific is limited on the north, the entire mass of water which is carried toward the east in the North Pacific must return, whereas in the South Pacific a considerable part of the water continues eastward to the south of South America. This circumstance perhaps explains the more conspicuous development of the westerly tropical current in the North Pacific.

Off the coast of Japan, in the latitude of Yokohama and to the north of this latitude, we find very complicated currents. No lines have been drawn, but by means of the numerical values on the chart, one easily recognizes the line of demarcation, representing the boundary between the warm water to the south and the cold water to the north, which was seen in Section IX. A warm current, the Kuroshio, can be traced as a narrow and very strong current which follows the southeast coast of Japan to approximately latitude 37° north. Here it meets the cold current coming from the northeast, the Kurile (Oyashio) Current. Both currents bend toward the east, the Kuroshio partly to the south and the Kurile Current partly to the north. Along the border of the two currents a succession of whirls is apparently developed and it is probable that future observations will show that these whirls develop at various places along the line of demarcation and reach varying intensities. The observations of the Carnegie indicate the major features of the current system but cannot be used for a discussion of the details. We remind the reader that a corresponding region with great contrasts is found in the North Atlantic to the south of the Grand Banks, and that corresponding whirls undoubtedly are developed there.

The whole of the North Pacific to the north of latitude 30° north is dominated by the easterly current, which in the southern part carries warm water of high salinity, and in the northern part carries cold water of low salinity. Because of the difference in temperature, the density is increasing toward the north. The observations of the Carnegie cannot disclose any details as to this current, but they show that it is strongly developed to a depth of more than 500 meters. The inclination of the isobaric surfaces toward the north in the North Pacific is the dominating feature in the topography of the surfaces.

The easterly current of the North Pacific divides into two branches when it strikes the coast of North America. The northern branch turns toward the north and bends into the Gulf of Alaska and returns toward the west on the southern side of the Aleutian Islands. This branch is shown in the British Admiralty Charts and in the chart by Merz, and appears in our charts, thanks to the observations made in the Gulf of Alaska by the United States Bureau of Fisheries.

The other and more important branch of the easterly current of the North Pacific bends toward the south. The form of the North American coast is probably of great importance to the turning of the current, and to the fact that the southerly current along the coast runs with a very high velocity off the coast of California where it is known as the California Current. As in the case of the Peruvian Current, the increase of density toward the coast cannot be ascribed to an upwelling of deep water, but is dynamically conditioned. The California Current, as it appears on our dynamic maps, is maintained by the difference of density between the subtropical and subarctic regions, but the increase in density toward the coast is a direct result of the existence of the current.

An upwelling takes place in the upper layers because of the transport of water away from the shore by prevailing winds. Thorade (1909) has shown that this transport and, consequently, the upwelling is subjected to considerable seasonal change. As to the character of the upwelling and the relation of this phenomenon to the low temperatures at greater depths, we refer to our discussion of the Peruvian Current. In this place it should again be emphasized that according to our conception the low surface temperatures are the result of an upwelling of water from small depths, whereas the low temperatures at greater depths have nothing to do with the upwelling, but are associated with the presence of a southerly current along the coast.

The rapid heating of the surface, which takes place in this southerly latitude, must lead to the development of a thin surface layer of relatively high temperature. The transition from this surface layer to the underlying water takes place in a short distance, and convective currents therefore cannot penetrate to any great depth. The velocity of the California Current decreases with increasing depth and at a depth of 400 meters the current is very weak.

In the regions between the coast of California and the Hawaiian Islands the currents are rather irregular. At the most northern stations we find, on the whole, an easterly current and at the most southern stations a westerly current, and between the Islands and the American coast the water flows mainly from the north. From the appearance of sections VII and XV, and from the curves showing the vertical distribution of temperature and salinity at stations 139 to 146, it appears as if a transport of water toward the north takes place in the upper layers at stations 142 to 146. The dynamic charts do not indicate such a transport, which perhaps must be attributed to the effect of the wind. Below a level of 200 or 300 meters the transport appears to take place principally from the west.

At the stations in the immediate vicinity of the Hawaiian Islands we find a rather strong surface current from the east which, however, decreases rapidly in velocity with increasing depth. The water of high salinity, which is found below the surface at stations 139 and 140, appears to come from the region of high salinity to the west.

The Equatorial Countercurrent is especially well dedeveloped in the Pacific. As a rule it is a little to the north of the equator, running with high velocity toward the east. It is probable that this current is extended across the whole width of the Pacific Ocean but it is undoubtedly subjected to considerable variations, partly of seasonal character and partly owing to circumstances of which we have no knowledge. It is generally assumed (Defant, 1928; Krümmel, 1911) that the Equatorial Countercurrent represents a compensation current carrying back again to the east part of the water which is transported toward the west by the trade-wind currents. Furthermore, it is assumed that this countercurrent,

which is known to be a narrow current on the surface, widens with depth. The latter conception, as to the increasing width of the Equatorial Countercurrent, cannot be upheld according to the Carnegie results; on the contrary, the current is typical of the upper layers only, and since it has a very limited extension it must be doubted that this flow of water represents a compensation action. It will be shown on the basis of the Carnegie data that the countercurrent probably is owing to the asymmetric development of the westerly tropical currents of the two hemispheres and to the effect of diverging surface currents in the vicinity of the equator.

Before turning to the observations of the Carnegie a few general considerations are necessary. Attention should be drawn to the fact that the inclination of the isobaric surfaces must change when passing the equator because of the change of the direction of the deflecting force of the earth's rotation. In other words, the isobaric surfaces must have a maximum or a minimum at the equator. If the isobaric surfaces had a definite inclination at the equator, the direction of the current would change by 180° when passing the equator and such a condition cannot be stable.

If the isobaric surfaces show a maximum at the equator, the surfaces are inclined to the north in the Northern Hemisphere and to the south in the Southern Hemisphere, and the current is directed toward the east on both sides. If, on the other hand, the isobaric surfaces have a minimum at the equator the current is directed toward the west.

We have seen previously that the westerly tropical currents in both hemispheres must be regarded as forced currents, which are maintained partly by the prevailing winds and partly by the density currents in the northern and southern parts of the ocean. Within these westerly tropical currents in the Northern Hemisphere we must have the heavy water to the left, which means near the equator, and in the Southern Hemisphere the heavy water must lie to the right, which also means near the equator. Therefore, since these forced currents toward the west exist, we must find an accumulation of heavy water in the vicinity of the equator. Assuming, for for the sake of simplicity, that we have two layers only, one light on top and one heavy below, the conditions have been represented schematically in figure 24a, in which the boundary surface between the two water masses shows an upheaval under the equator. Assuming the isobaric surfaces in the heavy water to be horizontal, the isobaric surfaces must have the courses which are indicated by means of the thin lines. In this case the topography of the isobaric surfaces shows a minimum at the equator, and within the light water, we find a current toward the west on both sides of the equator, whereas the heavy water is at rest. No countercurrent exists.

If, however, for some reason the accumulation of heavy water is asymmetric when referred to the equator, a different system is developed. The conditions which are shown in figure 24b cannot exist. We cannot find a single upheaval of the heavy water on one side of the equator because this would give the isobaric surfaces an inclination at the equator. Considering that the isobaric surfaces must have a maximum or a minimum at the equator, two types of asymmetric development are possible, as shown in figures 24c and 24d. In figure 24c we have a small upheaval of the heavy water under the equator and a big upheaval to the north. When such a distribution of density is present, the isobaric surfaces show two minima, one at the equator and one to the north of the equator. These two minima are separated by a maximum and the water in the region between this maximum and the northern deep minimum must flow to the east. That means that here we find a countercurrent which, however, is present in the upper light water only. The light water reaches to greater depths to the north and to the south of the minima and the westerly current is, therefore, deeper than the countercurrent. In the second case, figure 24d, we find accumulations of heavy water on both sides of the equator but the accumulation on the northern side is the greater. The isobaric surfaces show a maximum at the equator and minima on both sides, and between the two minima a countercurrent flows toward the east. The case in which the two upheavals of the heavy water are equally developed is probably of minor interest because then symmetry exists as to the equator and the simpler system in figure 24a seems more probable. The greatest upheaval may, of course, be found in the Southern Hemisphere, but this cannot lead to any principal differences.

From these considerations it seems probable that an asymmetric development of the westerly tropical currents may give rise to an asymmetric accumulation of heavy water near the equator, and that the dynamic system which then is established leads to the countercurrent toward the east between the two westerly currents. The width of the countercurrent and the one-sided development in reference to the equator depends on the character of the asymmetry, but the countercurrent must in all cases be regarded as a dynamically conditioned current.[1]

We have the possibility of discussing the equatorial currents for two occasions when the Carnegie crossed the equator. The sections were both taken in directions which form angles less than 90° with the equator, but, for the sake of simplicity, we shall plot the values as if they were taken along two meridians; that is, we shall plot the stations at the observed latitudes and disregard the differences in longitude between the stations. The eastern section is taken nearly in the central part of the Pacific along the average meridian of 145° west, whereas the western section is taken in the western half of the Pacific approximately along the meridian of 180°.

In order to study these sections we have computed the distances in dynamic meters between the isobaric surface of 700 decibars and the isobaric surfaces 0, 50, 100, 150, 200, 250, and 300 decibars. We have selected the isobaric surface of 700 decibars as the reference surface because this surface is practically parallel to the surface of 2000 meters. Also, accidental errors of observation exercise a greater influence at depths below 700 meters since the intervals between the observations there are greater. Assuming the isobaric surface of 700 decibars to be horizontal, we have constructed

[1] Later on the author (1939) has pointed out that the observed distribution of mass does not given any clue to the understanding of the dynamics of the countercurrent. The dynamics have recently been discussed by Montgomery (1940) and by Montgomery and Palmén (1940). They state that the trade winds by continually exerting a westward stress on the sea surface produce a westward ascent of the sea level in the equatorial region. The equatorial countercurrents are found in the doldrums and apparently result as a down slope flowing in this zone where the winds maintaining the slope are absent.

profiles of the isobaric surfaces down to the surface of 300 decibars. Furthermore, we have represented the distribution of density, salinity, and temperature by means of vertical sections which are extended to a depth of 300 meters, and in the case of the central section we have also represented the amount of oxygen, but from the western section no observations of oxygen are available.

The profiles of the isobaric surfaces of the central section are represented in figure 25. As in the other vertical sections, north is to the right and south is to the left. These profiles are of the type shown schematically in figure 24c. When drawing them, one has a certain freedom because of the considerable distances between the stations, but a minimum must be placed somewhere near the equator, and then it is permissible to place it at the equator where it theoretically should be.

It is seen on the figures that currents toward the west are dominating. At the surface they are found to the north of latitude 10° north and to the south of latitude 03° 40′ north. Currents in the opposite direction, toward the east, are at the surface between the two latitudes 10° and 7° 30′ north. Within these latitudes the Equatorial Countercurrent is fully developed. The most interesting feature shown by the profiles is that the velocity of the countercurrent decreases very rapidly with increasing depth. At a level of 100 meters it is already much weaker than at the surface, and at a level of 200 meters it has practically disappeared. The westerly current also decreases with increasing depth, especially near the equator, but in latitudes 20° north and 10° south a considerable current toward the west still exists at 300 meters. These observations show that the Equatorial Countercurrent does not widen with depth but, on the contrary, becomes narrower and narrower, and disappears above a level of 200 meters.

Turning next to the western section, figure 30, we find essentially the same features but here the profiles of the isobaric surfaces are of the type shown in figure 24d. In this case, a maximum must be placed somewhere near the equator, and it is permissible to place it at the equator, in agreement with the theoretical conditions.

The currents toward the west are also dominating here, extending to the north of latitude 6° 20′ north and to the south of latitude 3° 20′ south. Between latitudes 6° 20′ north and 3° 20′ south the current runs in the opposite direction, toward the east. In this case we find a maximum elevation of the isobaric surfaces at the equator. The Equatorial Countercurrent is thus extended over a broad area on both sides of the equator. It has its maximum velocity somewhat below the surface at a level of about 100 meters but from this level the velocity decreases rapidly with increasing depth until the current practically disappears at 300 meters. The currents toward the west also decrease with increasing depth, especially at the shortest distance from the equator as was the case in the preceding section. The two sections give us essentially the same results. The different position and development of the countercurrent may perhaps be explained by the fact that the western section was taken in April, at the beginning of the northern summer, whereas the central section was taken in November, at the beginning of the southern summer, but it also may be related to the different geographic locations.

The different development of the countercurrent at the two crossings of the equator makes it impossible to combine the observations to form a consistent picture of the topography of the isobaric surfaces in the vicinity of the equator. There the lines of equal elevation in the charts, therefore, have no physical significance.

The density sections, figures 26 and 31, give the same picture in both cases. We find accumulations of heavy water under the northern and southern borders of the countercurrent, whereas lighter water extends to greater depths within the countercurrent itself. In the central section the upheaval of the cold water is especially characteristic at the northern border of the countercurrent.

Turning to the salinity, temperature, and oxygen sections, figures 27, 28, and 29 from the central region, we obtain some information as to the character of the vertical motion. From the salinity sections it is evident that we find ascending motion along the borders of the westerly currents. The ascending motion is especially strong on the northern side of the countercurrent, where water of low salinity is brought practically to the surface. The course of the isohalines indicates that the surface water is driven away from the countercurrent both on the northern and the southern sides, and the salinity section, therefore, supports the opinion that diverging surface currents are present and are of importance to the development of the system. The temperature section discloses the same features as the salinity sections. It shows especially the upward movement on both sides of the countercurrent and, in addition, a downward movement at the southern boundary.

The oxygen section, figure 29, shows some very interesting features. The axis of the lowest salinity values in the salinity section follows exactly the line of 4 ml/L. The ascending water on the northern side has thus, on the whole, an oxygen content above 4 ml/L. On the southern side we find that the ascending water has a somewhat lower oxygen content, namely, 3 ml/L. The descending movement at the southern boundary of the countercurrent can hardly reach to any considerable depth because even in the central part we find a rapid decrease of the oxygen content below a level of 150 meters.

A very rapid change of density with depth is found at a short distance below the surface at the stations where the heavy deep water reaches almost to the surface, and where the stable stratification prevents mixing between surface water and the deep water. The deep water, which rises as a wedge at the northern border of the countercurrent, is without any communication with the surface water and consequently we find that this deep water is practically without oxygen. Values as low as 0.03 ml/L were observed in this region and values below 0.25 ml/L occur within an extensive mass of water. The contrasts are smaller on the southern side of the countercurrent where the density changes more gradually with depth, and where a slow mixing between the surface waters and the deep waters may take place.

The western temperature and salinity sections show several features which are similar to those of the central regions, but the contrasts are less conspicuous and the indications of vertical movement are less definite. From the salinity section it is evident that ascending motion takes place along the borders of the westerly currents, especially on the northern side of the countercurrent.

The conditions which are revealed by the observations

of the Carnegie are in close agreement with our general considerations. On both sides of the equator we find westerly currents reaching to considerable depths and there separated by heavy water which is practically at rest. Between the westerly currents the countercurrent is embedded as a swift but shallow current. The heavy water at rest reaches nearest the surface at the northern and southern boundaries of the countercurrent.

Intermediate Currents

We have already discussed the origin of the intermediate water of low salinity in the Southern Hemisphere and have shown that this water probably sinks at the Antarctic convergence. When studying the sections we found the axis of the intermediate current at a depth of 600 to 700 meters within the areas from which observations are available. These areas are so limited, however, that we cannot follow the flow of the intermediate current and our dynamic charts give only some hints as to the character of this current. From the dynamic charts for the levels 500, 700, and 1000 meters it looks as if the circulation of the intermediate current takes place in a clockwise direction, contrary to the tropospheric circulation which is counterclockwise. This result needs confirmation, but what seems certain is that the flow of the water takes place principally in an east and west direction and that the north and south component of the current is very weak in the central part of the South Pacific. The flow of water, which at the 700-meter level is directed away from the coast of South America, perhaps transports back again part of the water which is carried toward the coast by the currents of the troposphere. The westerly current off the coast at a depth of 700 meters should then be regarded as a compensation current.

In the Northern Hemisphere the circulation of the intermediate water takes place in the same direction as the circulation within the troposphere and is in both cases clockwise. We have seen that the intermediate water probably is formed in the eddies which develop off the coast of Japan at the boundary between the warm current from the southwest and the cold current from the northeast. Water of a salinity between 33.09 and 34.00 per mille and of a temperature of about 5°, which is formed in this region, is transported toward the east, turns toward the south when approaching the American coast, and returns toward the west in approximately latitude 20° north. On this journey both the temperature and the salinity of the water increase because of the processes of mixing. The water, therefore, has a higher temperature and a higher salinity when it bends toward the north on the west side of the ocean after having completed one circuit, than it had when beginning the circuit. When carried toward the north it is mixed with water of lower temperature and lower salinity coming from the north, and new water of the typical properties of the intermediate layer is again formed. This new water compensates for the loss which has taken place because of the processes of mixing, and because a transport of intermediate water toward the equator probably exists, as was shown when dealing with the Equatorial Countercurrent.

The intermediate current in the Northern Hemisphere is, on the whole, a subsurface current, in contrast with the corresponding current in the Southern Hemisphere which originates at the surface. The difference in the oxygen content of the intermediate water supports this conception (see p. 50).

Velocity of Currents between the Surface and 700 Meters

Up to this point the discussion of the currents has been based on the topography of the isobaric surfaces, and the currents have been treated qualitatively only. Current charts 0 to 700 meters (figs. 34 to 38) show direction and velocity of the currents, as computed from the inclination of the isobaric surfaces, supposing that the conditions are stationary, and that the motion is frictionless and negligible at the 2000-decibar surface. It must again be emphasized that the values in the figures are obtained by combining observations, which in several regions were made at great intervals of time. This combination may lead to apparent irregularities, especially in regions where the currents undergo considerable displacement. Also in the vicinity of the equator the computed velocities are uncertain because of the topography of the isobaric surfaces and because there the friction may play a greater part than elsewhere. In spite of these reservations, however, it is probable that the charts show the approximate order of magnitude of the currents which are maintained by the distribution of density.

In the Southern Hemisphere the easterly current of the South Pacific shows velocities which, at the surface, vary from 2 to 9 cm/sec, increase to a depth of 100 meters where they reach 12 cm/sec, and decrease rapidly below 100 meters. At 400 meters the eastward velocities are only 3 cm/sec or less, and at 700 meters the direction is reversed, the water flowing toward the west with a velocity of 1 to 2 cm/sec. The Peruvian Current appears to be a very weak current. At the surface the velocities range from 2 to 5 cm/sec and decrease downward to about 2 cm/sec at 700 meters.

Within the westerly tropical current of the South Pacific we find surface velocities up to 30 cm/sec, 14 nautical miles in 24 hours. Still greater velocities are met with at 100 meters, but below this level the velocities decrease rapidly and at 700 meters no distinct motion toward the west is perceptible. The irregular character of the westerly tropical current of the Southern Hemisphere is clearly evident from the figures.

In the northern Hemisphere the westerly tropical current shows the greatest velocities near the surface, where they approach 30 cm/sec. The velocities decrease with increasing depth, and at the same time the current is being displaced toward the north. At 700 meters the velocities are less than 2 cm/sec.

At the surface, in longitude 140° west, the Equatorial Countercurrent has a velocity of about 50 cm/sec, or nearly 24 nautical miles in 24 hours. This value is again very probable. At greater depths the countercurrent disappears, and the crosscurrents, which are shown at 700 meters, probably have no real significance.

The warm current along the coast of Japan, the Kuroshio, is not represented in the figures, but the cold Kurile Current (Oyashio) is seen at all levels. The velocity of this current decreases from 17 cm/sec at the surface to about 2 cm/sec at 700 meters. The changes in the direction of the current with depth are perhaps associated with the presence of whirls.

The easterly current in the northern part of the North Pacific can be traced at all levels. The velocities decrease with increasing depth, from 2 to 9 cm/sec at

the surface and 100 meters to 0.8 - 3 cm/sec at 700 meters.

The westerly current in the Gulf of Alaska has a velocity of 7 cm/sec at the surface, but at 400 meters it has practically disappeared. The southerly current along the coast of California shows a velocity of 17 cm/sec at the surface. This velocity also decreases downward, but below 400 meters the decrease appears to be very small because at the levels 400 and 700 meters the computed velocities are 4.3 and 4.2 cm/sec respectively.

The numerical values which are shown in the figures and briefly treated here give, no doubt, a fairly correct idea of the intensity of the circulation in the Pacific, especially in the North Pacific, down to a depth of 700 meters, but the picture will probably be much modified in details when more observations become available.

Flow of the Deep Water

Since high temperatures are found in the equatorial regions, it is probable that a slow descending motion takes place here and that the circulation is to some extent, therefore, as suggested by Wüst (1930). The descending water, however, cannot contribute directly to the formation of the typical deep water because of its high temperature and low salinity, but must spread to the north and the south above the deep water.

In the North Pacific the bottom water and the deep water must come from the south because it cannot be formed anywhere in the area of the North Pacific. The inflow probably takes place near the bottom because there the highest oxygen values are found. The low temperatures in the northern part of the North Pacific at the levels below 2000 meters suggest an ascending motion of the deep water in this region. If this is correct, we must assume that the deep water returns to the south at a level between 2000 and 1000 meters, and on this journey it is being mixed with water from the intermediate current.

The deep water of the South Pacific must also come from the south and the greater part probably enters the Pacific to the south of New Zealand. Part of the deep water flowing into the South Pacific continues to the North Pacific, but another part probably ascends when approaching the equator and returns to the south at levels above 2000 meters. The distribution of oxygen leads to this suggestion.

It has already been indicated that at levels above 2000 to 1000 meters the water of the North Pacific probably moves to the south and thus flows into the South Pacific. At levels below 1000 meters the oxygen content, however, is much higher in the South Pacific than in the North Pacific, and this could not be the case if the water at these levels came from the North Pacific only. Therefore, in the South Pacific the return current above 2000 meters must carry water which mainly has been circulating in the South Pacific only, and with which some water from the North Pacific has been mixed.

It must be emphasized, however, that at any level the flow in an east-west direction is considerably stronger than the flow in a north-south direction. Because of this circumstance and of the obvious differences in the currents of the eastern and western parts of the ocean, no attempt has been made to give a schematic representation of the meridianal circulation in the Pacific Ocean. Such a representation would contain too many hypothetical elements, because at present it is not possible to arrive at any definite conclusions as to the flow of the deep water. Some possibilities have been suggested but these and others cannot be examined more closely before a greater number of observations are at hand.

LITERATURE CITED

Clowes, A. J. 1933. Influence of the Pacific on the circulation in the South-West Atlantic Ocean. Nature, vol. 131, London.

Defant, A. 1928. Die systematische Erforschung des Weltmeeres. Ztschr. Gesellsch. Erdk., Sonderband zur Hundertjahrfeier. Berlin.

Discovery Reports. 1930. Vol. 3. Cambridge.

Helland-Hansen, B. 1912. The depths of the ocean by Sir John Murray and Dr. Johan Hjort. Physical Oceanography, p. 276. London.

——— 1918. Nogen hydrografiske metoder. Skand. Naturforsker möte, Kristiania (Oslo).

——— 1930. Physical oceanography and meteorology. Rept. Sci. Results Michael Sars N. Atlantic deep-sea exped., 1910. Bergen.

——— and F. Nansen. 1926. The Eastern North Atlantic. Geof. Pub., vol. 55, no. 2. Oslo.

Howard, A. 1940. Hydrology, Programme of work and record of observations. B.A.N.Z. Antarctic Res. Exped. 1921-1931. Repts. ser. A, vol. 3, Oceanography, pt. 2, sec. 2, pp. 24-86.

Jacobsen, J. P. 1929. Contribution to the hydrography of the North Atlantic. The Danish Dana exped., 1920-1922, no. 3. Copenhagen.

Krümmel, Otto. 1911. Handbuch der Ozeanographie, vol. 2.

Möller, L. 1929. Die Zirkulation des Indischen Ozeans. Auf Grund von Temperatur-und Salzgehaltstiefenmessunger und Oberflächenstrombeobachtungen. Inst. f. Meeresk., Veröff., N.F., A, no. 21, 48 pp.

Montgomery, R. B. 1940. The present evidence of the importance of lateral mixing processes in the ocean. Bull. Amer. Meteorl. Soc., vol. 21, pp. 87-94.

——— and E. Palmén. 1940. Contribution to the question of the Equatorial Countercurrent. Jour. Marine Res., vol. 3, pp. 112-133.

Mosby, Haakon. 1934. The waters of the Atlantic Antarctic Ocean. Sci. Results Norwegian Antarctic Exped. 1927-1928 et sqq., instituted and financed by Consul Lars Christensen. No. 11. Det Norske Videnskapsakademi, Oslo.

Palmén, E. 1930. Ein Beitrag zur Berechnung der Strömungen in einem begrenzten und geschichten Meere. Rap. et Procés-Verbaux des Réunions du Conseil Perm. Internat. Expl. Mer, vol. 64. Copenhagen.

Puls, C. 1895. Oberflächentemperaturen usw. des Äquatorialgürtels des Stillen Ozeans. Archiv Deut. Seewarte, vol. 18, no. 1.

Schott, G. 1928. Die Verteilung des Salzgehaltes im Oberflächenwasser der Ozeane. Ann. d. Hydrogr., vol. 56, pp. 145-166. Berlin.

——— and F. Schu. 1910. Die Wärmeverteilung in den Tiefen des Stillen Ozeans. Ann. d. Hydrogr., vol. 38. Berlin.

Sverdrup, H. U. 1931. The origin of the deep water of the Pacific Ocean. Gerlands Beitr. zur. Geophysik, vol. 29. Leipzig.

——— 1939. Oceanic circulation. Proc. Fifth Internat. Cong. Applied Mech., 1938, pp. 279-293. New York.

——— 1940. Hydrology, Discussion. B.A.N.Z. Antarctic Res. Exped. 1921-1931. Repts. ser. A, vol. 3, Oceanography, pt. 2, sec. 2, pp. 88-126.

Thorade, H. 1909. Ueber die Kalifornische Meeresströmung. Ann. d. Hydrogr., vol. 37, pp. 17-34, 63-76.

Wüst, G. 1928. Der Ursprung des Atlantischen Tiefenwässer. Ztschr. Gesellsch. Erdk. Sonderband zur Hundertjahrfeier. Berlin.

——— 1929. Schichtung und Tiefenzirkulation des Pazifischen Ozeans. Veröff. Inst. Meeresk., N.F., A, no. 20. Berlin.

——— 1930. Meridionale Schichtung und Tiefenzirkulation in den Westhälften der drei Ozeane. Jour. du Conseil Internat. Expl. Mer, vol. 5, no. 1. Copenhagen.

——— 1935. Schichtung und Zirkulation des Atlantischen Ozeans. Die Stratosphäre. Wissensch. Erbegn. d. Deut. Atlantischen Exped. auf dem Forschungs-und Vermessungsschiff Meteor 1925-1927, vol. 6, pt. 1, sec. 2. Berlin.

FIGURES 1 - 38

TITLE

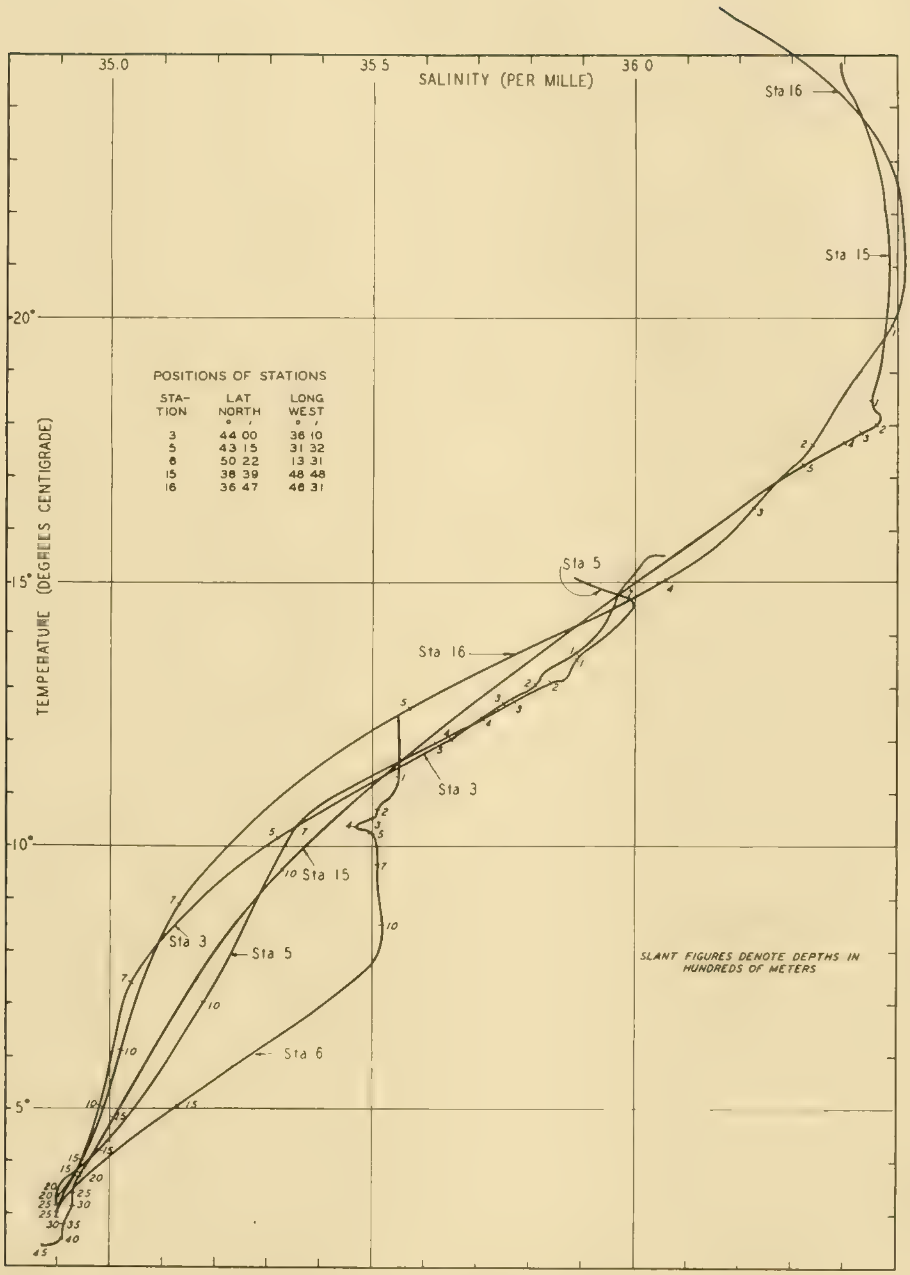


FIG. 1—SALINITY-TEMPERATURE RELATION, CENTRAL NORTH ATLANTIC OCEAN, STATIONS 3, 5, 6, 15, 16, CARNEGIE RESULTS, 1928

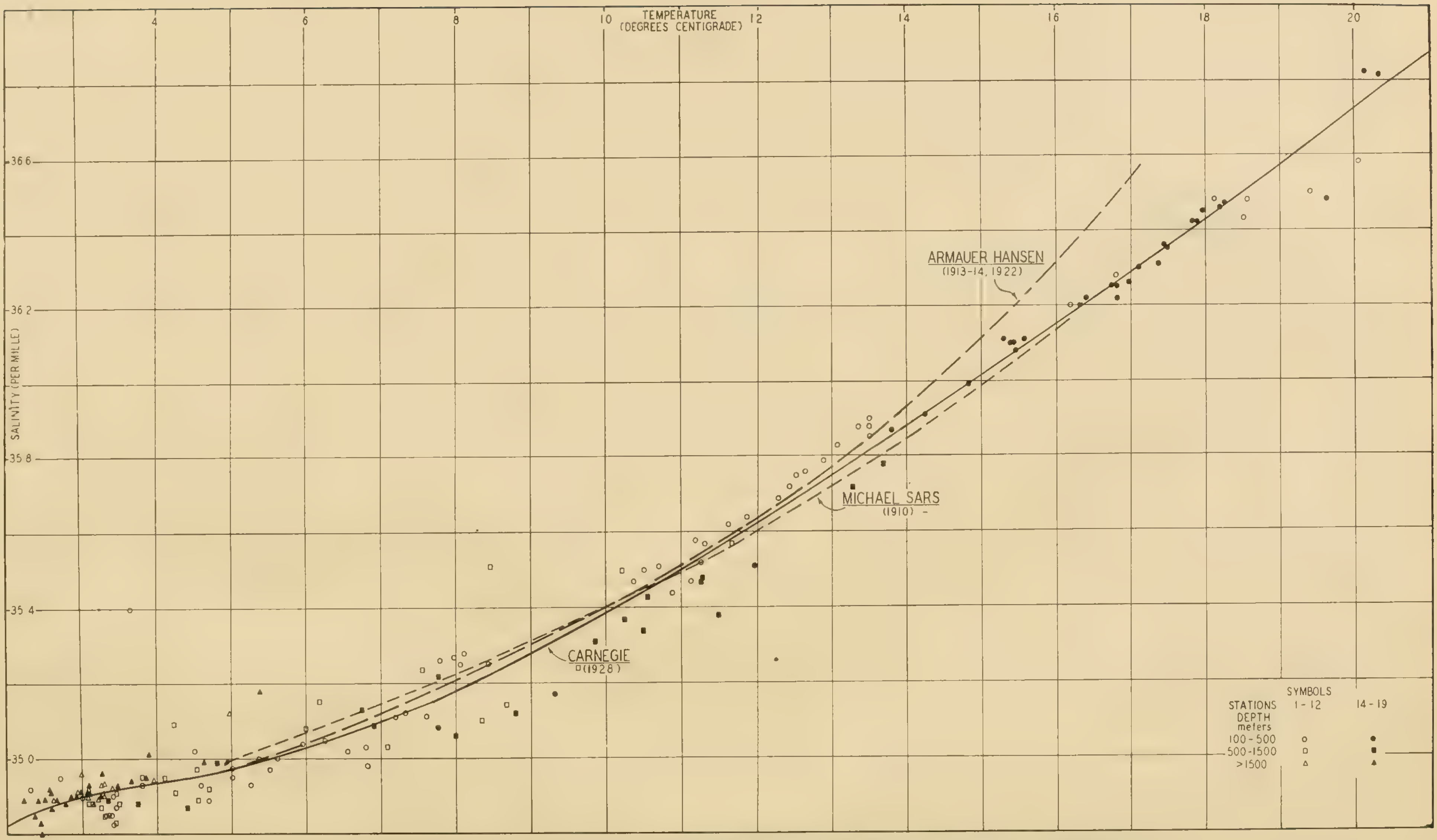


FIG 2—TEMPERATURE-SALINITY RELATION, ATLANTIC OCEAN, FROM MICHAEL SARS, ARMAUER HANSEN, AND CARNEGIE RESULTS

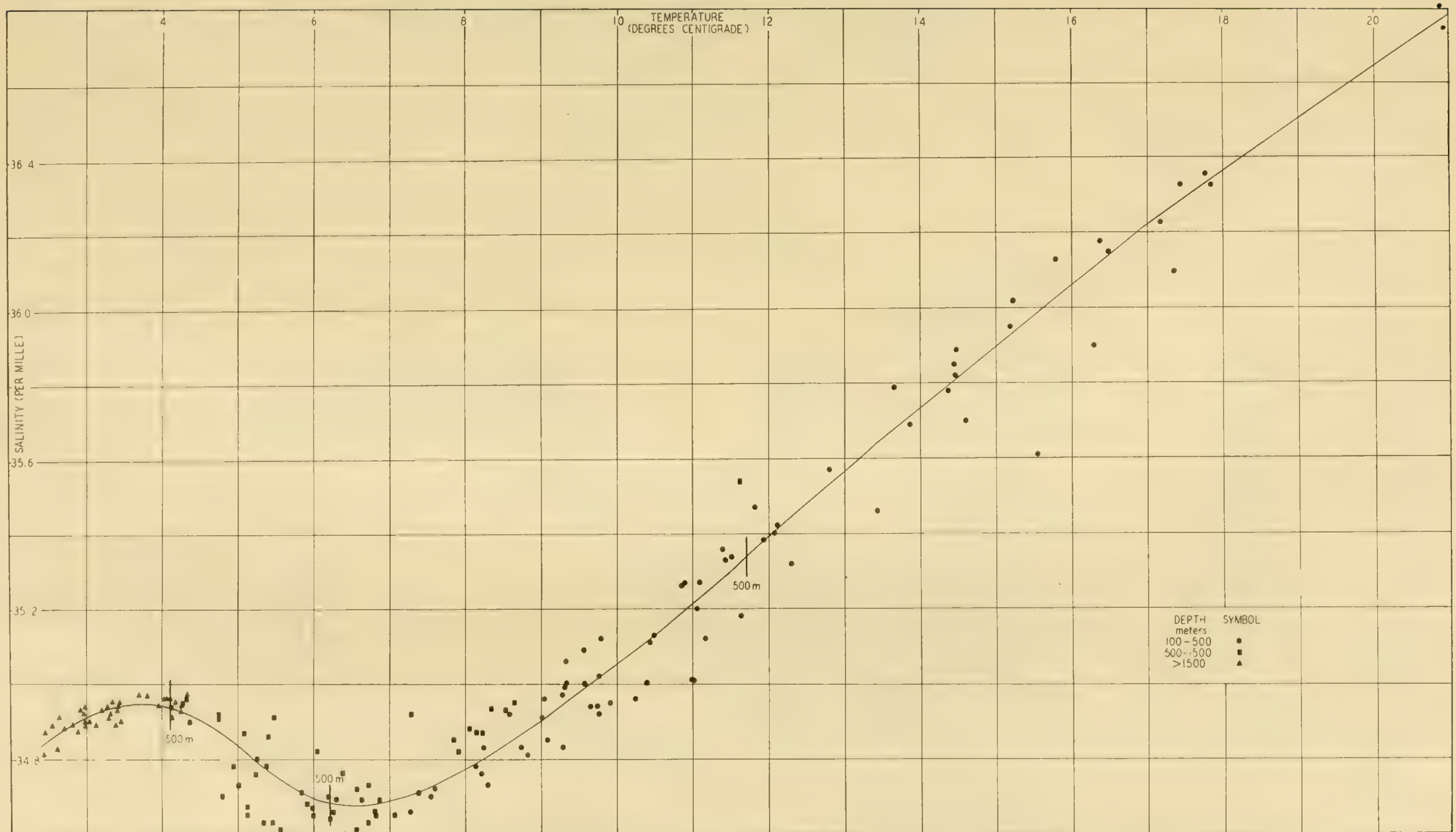


FIG 3 —COMPOSITE TEMPERATURE-SALINITY RELATION, STATIONS 20–34, ATLANTIC OCEAN AND CARIBBEAN SEA, FROM CARNEGIE RESULTS, 1928

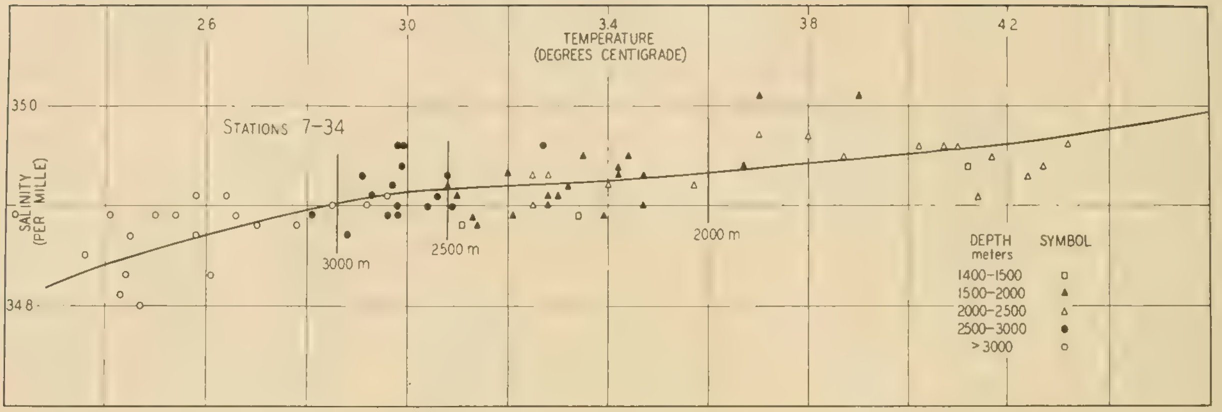


FIG. 4—COMPOSITE TEMPERATURE-SALINITY RELATION, DEEP WATER ATLANTIC OCEAN, FROM CARNEGIE RESULTS, 1928

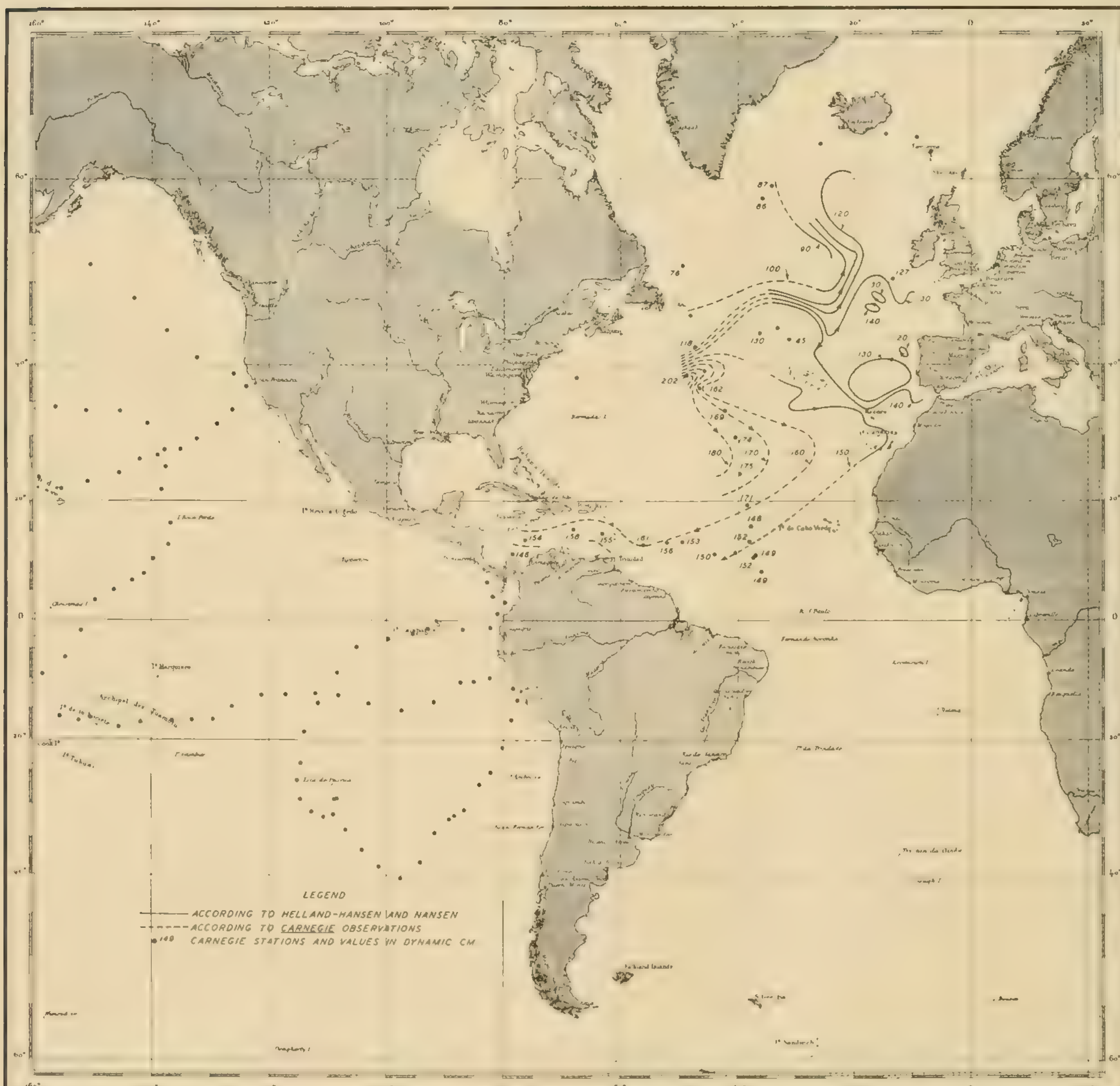


FIG. 5—DYNAMIC TOPOGRAPHY OF THE 100-DECIBAR SURFACE RELATIVE TO THE 2000-DECIBAR SURFACE, NORTH ATLANTIC OCEAN

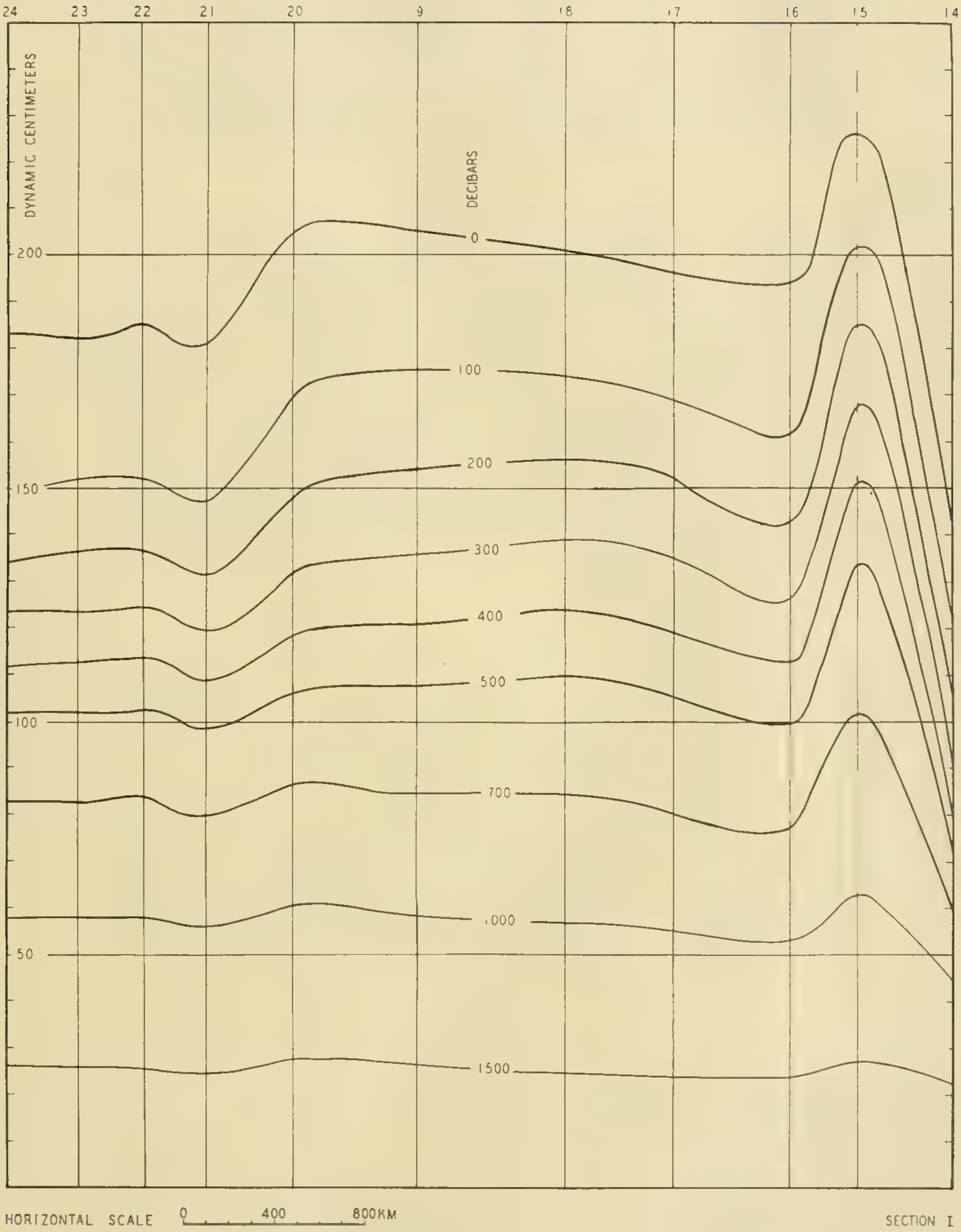


FIG. 6—PROFILE ISOBARIC SURFACES, ATLANTIC OCEAN, FROM CARNEGIE RESULTS, 1928

FIG. 7—STATIONS OF TEMPERATURE AND SALINITY OBSERVATIONS, DEPTHS GREATER THAN 3000 METERS, PACIFIC OCEAN, CARNEGIE AND PREVIOUS VALUES

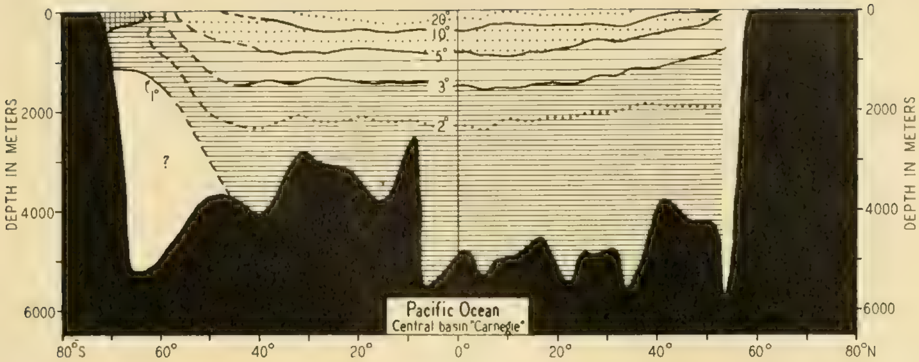


FIG. 8—VERTICAL DISTRIBUTION TEMPERATURE IN CENTRAL PART OF PACIFIC

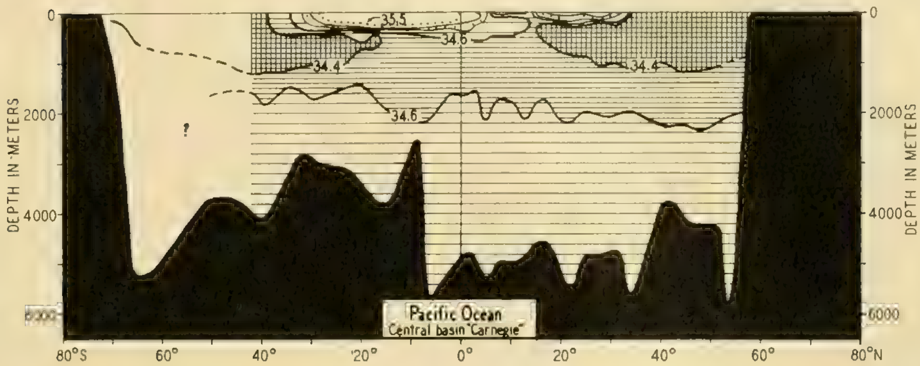


FIG. 9—VERTICAL DISTRIBUTION SALINITY IN CENTRAL PART OF PACIFIC

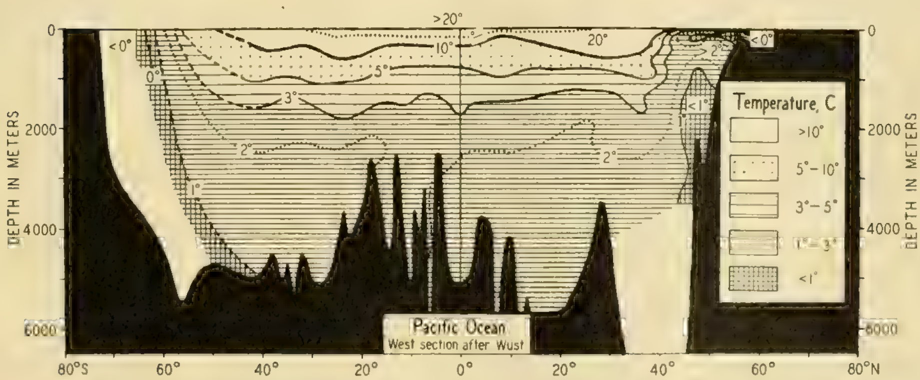


FIG. 10—VERTICAL DISTRIBUTION TEMPERATURE IN WESTERN PART OF PACIFIC
(ACCORDING TO WÜST)

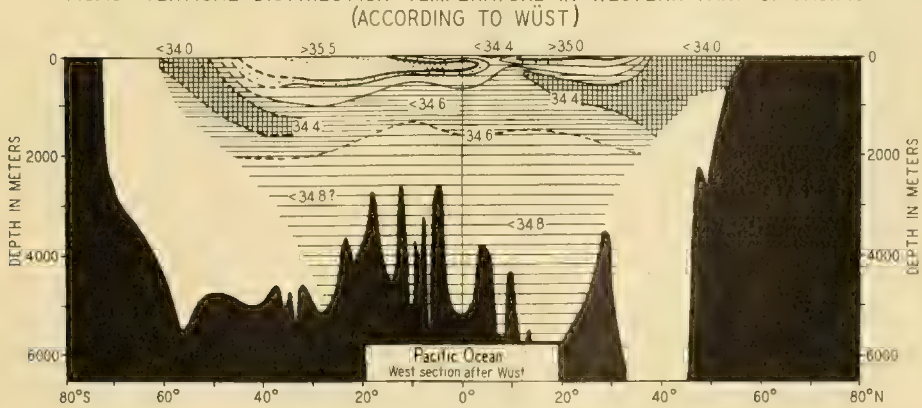


FIG. 11—VERTICAL DISTRIBUTION SALINITY IN WESTERN PART OF PACIFIC
(ACCORDING TO WÜST)

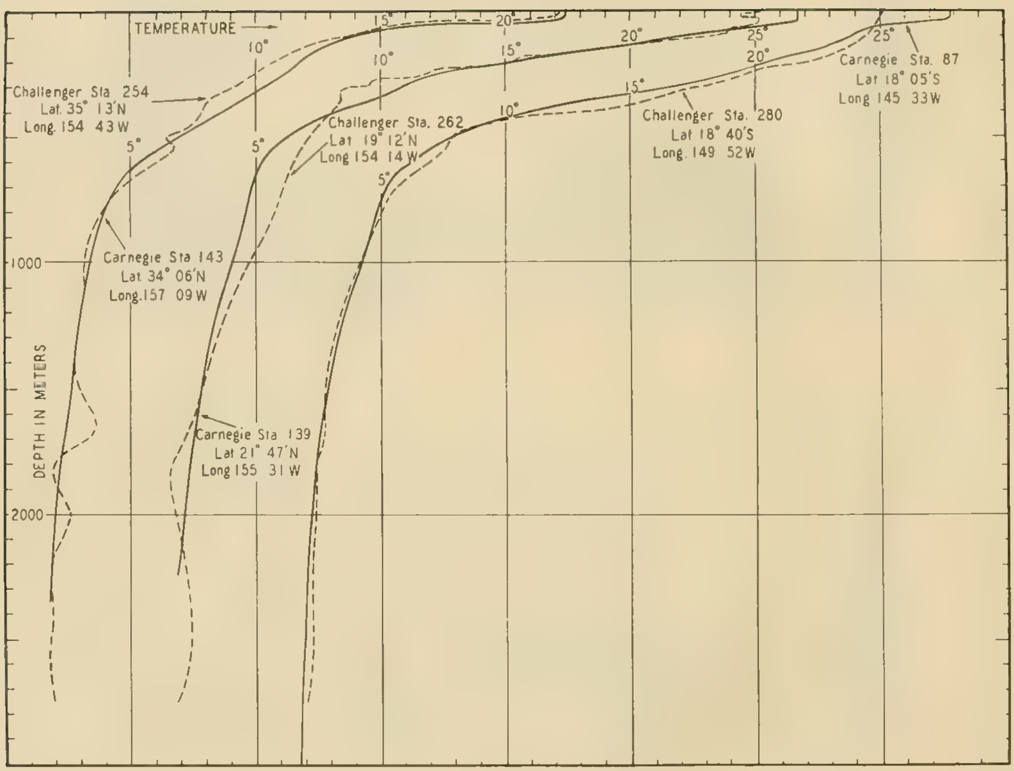


FIG. 12—COMPARISON TEMPERATURE OBSERVATIONS, CHALLENGER, 1875, AND CARNEGIE, 1929

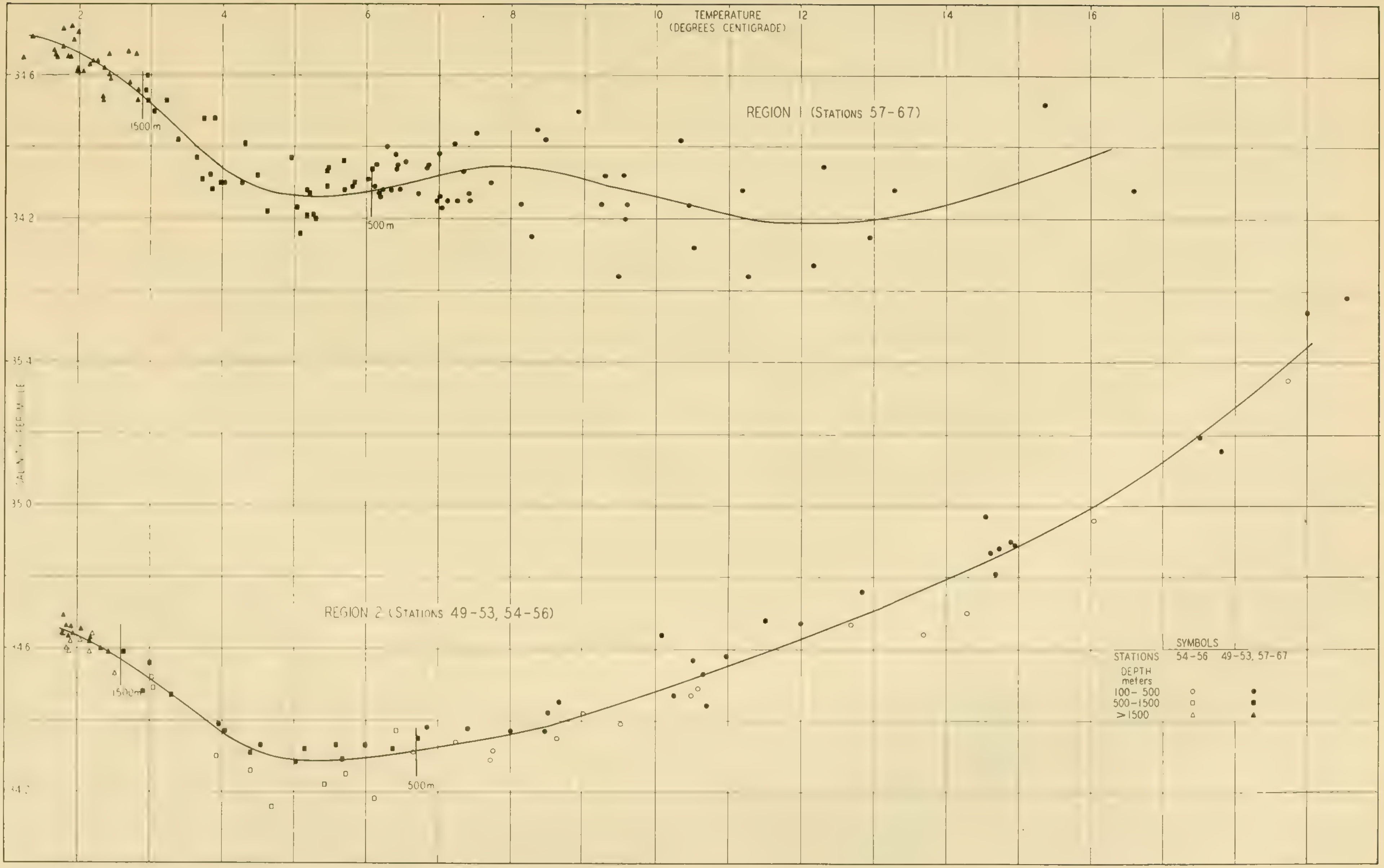


FIG. 13—COMPOSITE TEMPERATURE-SALINITY RELATION, REGIONS 1-2, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928-1929

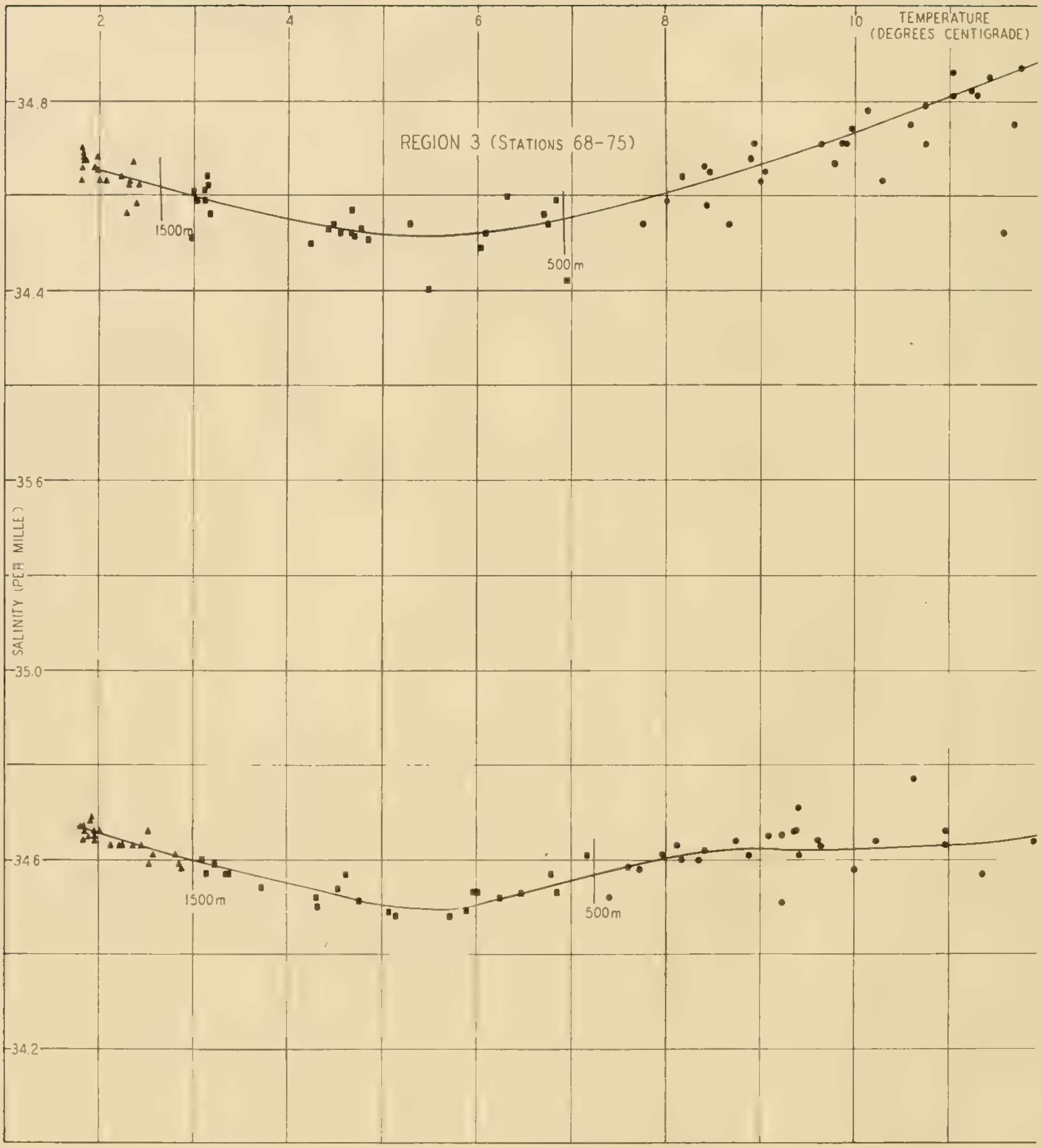
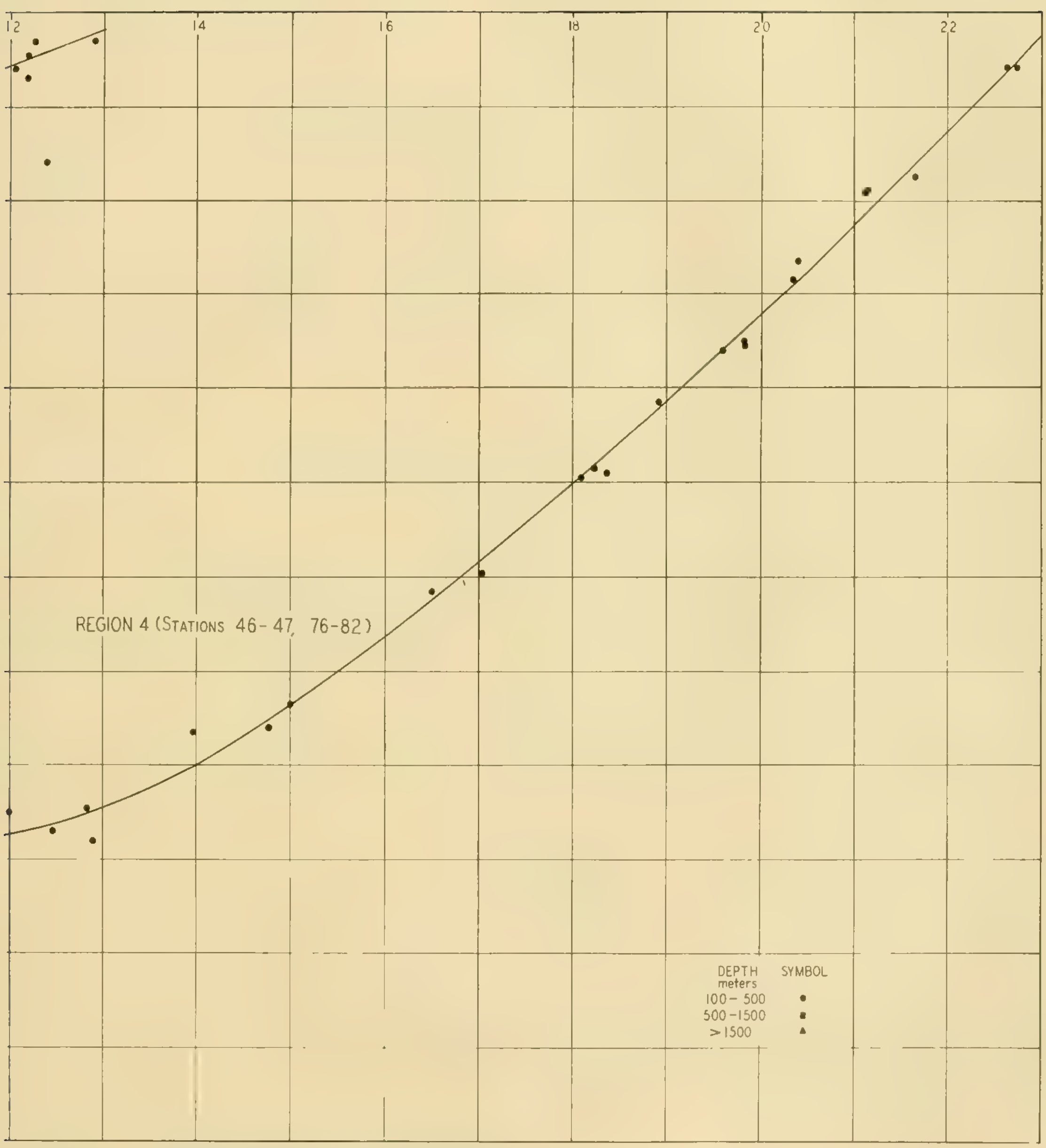


FIG. 14—COMPOSITE TEMPERATURE-SALINITY RELATION, REGIONS



3-4, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928-1929

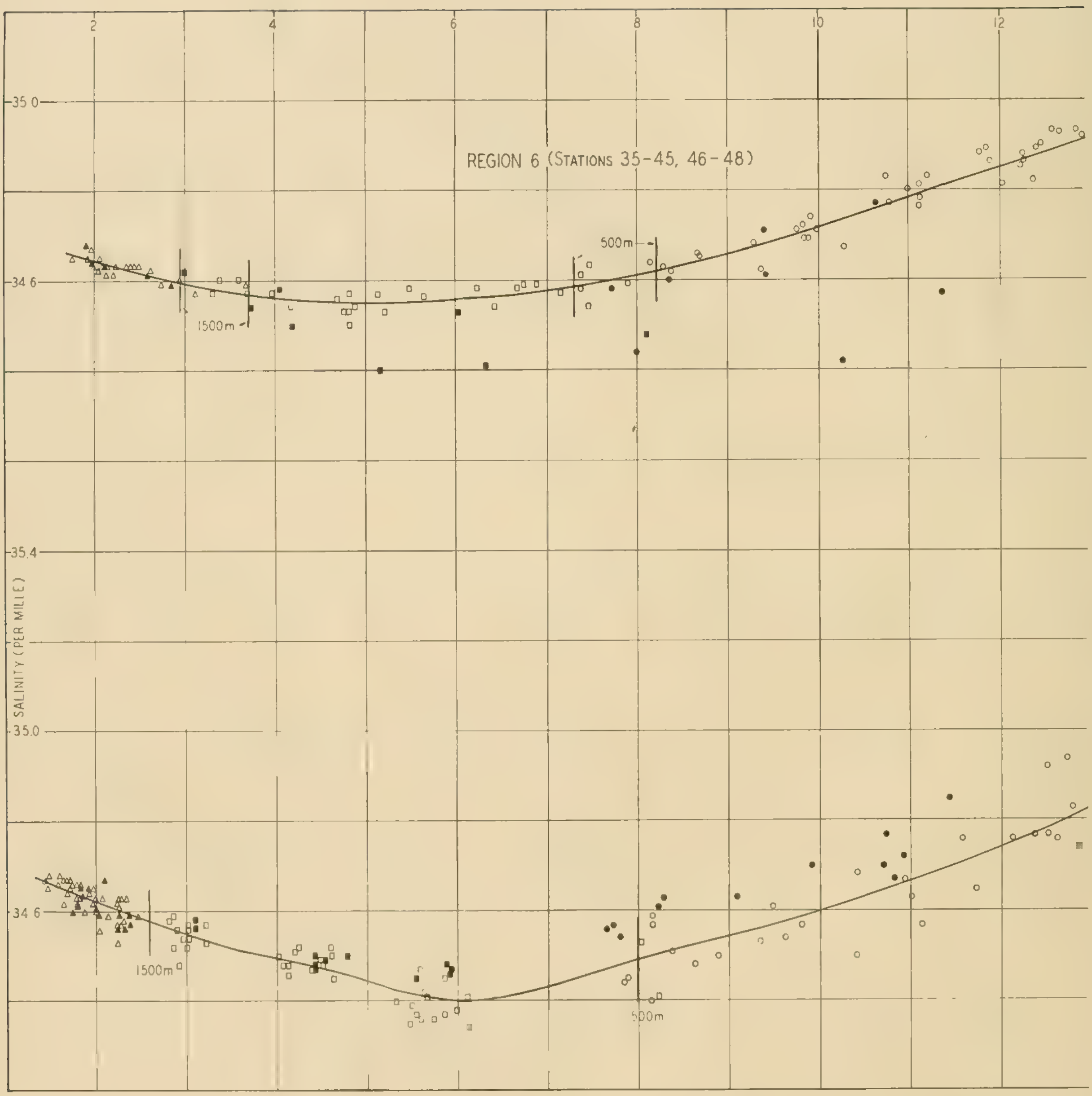
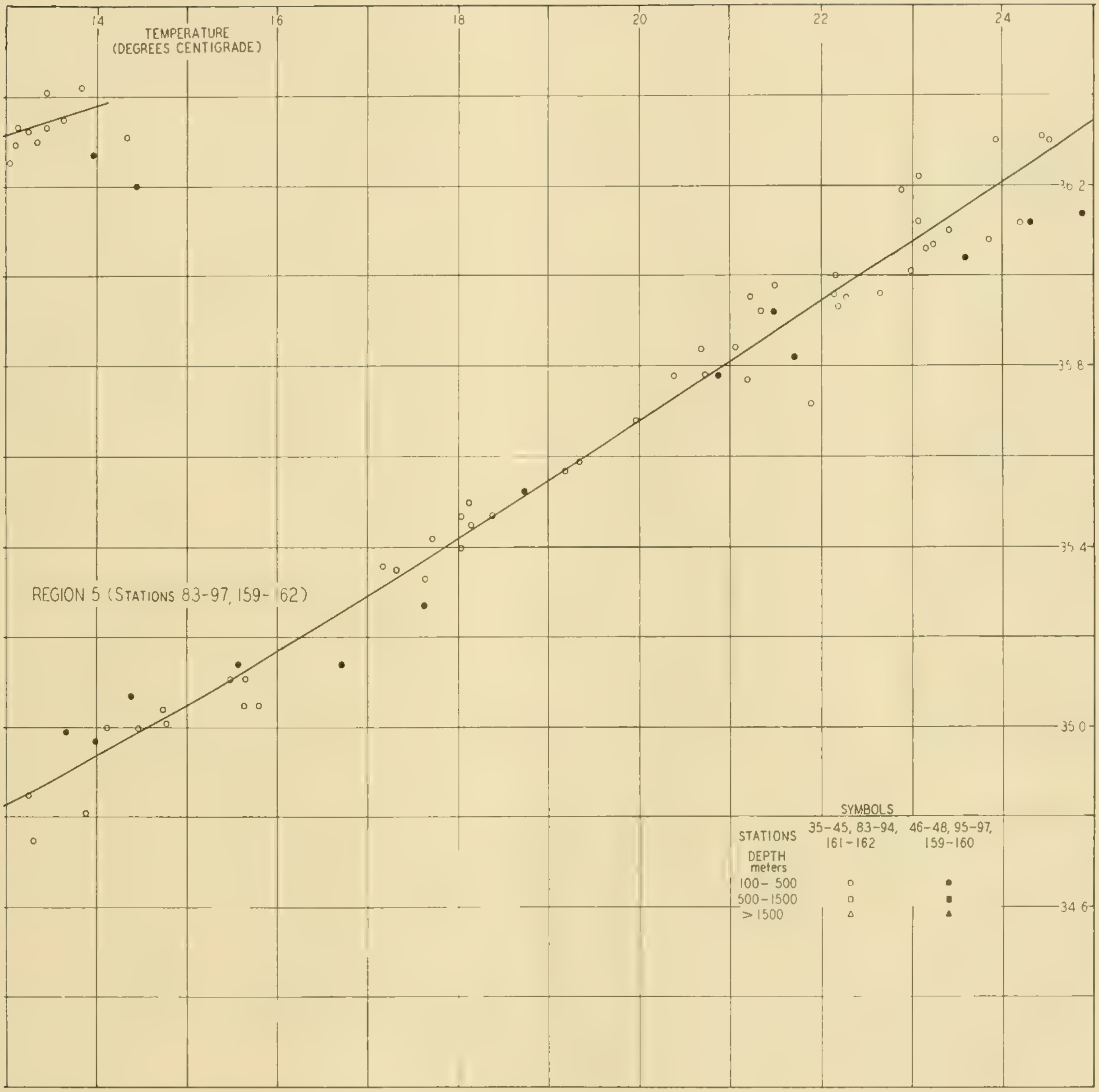


FIG. 15 — COMPOSITE TEMPERATURE-SALINITY RELATION, REGIONS



5–6, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928–1929

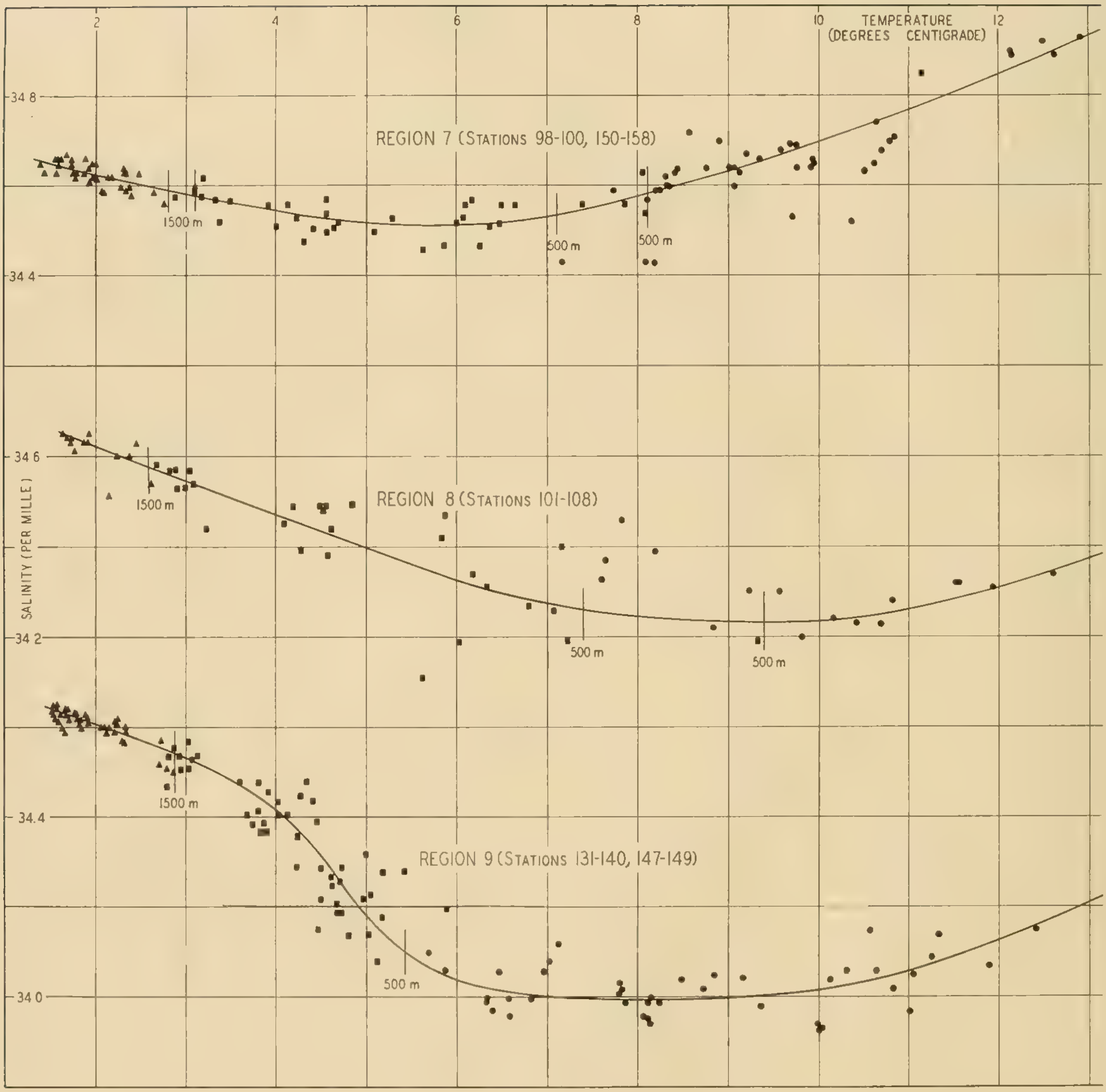
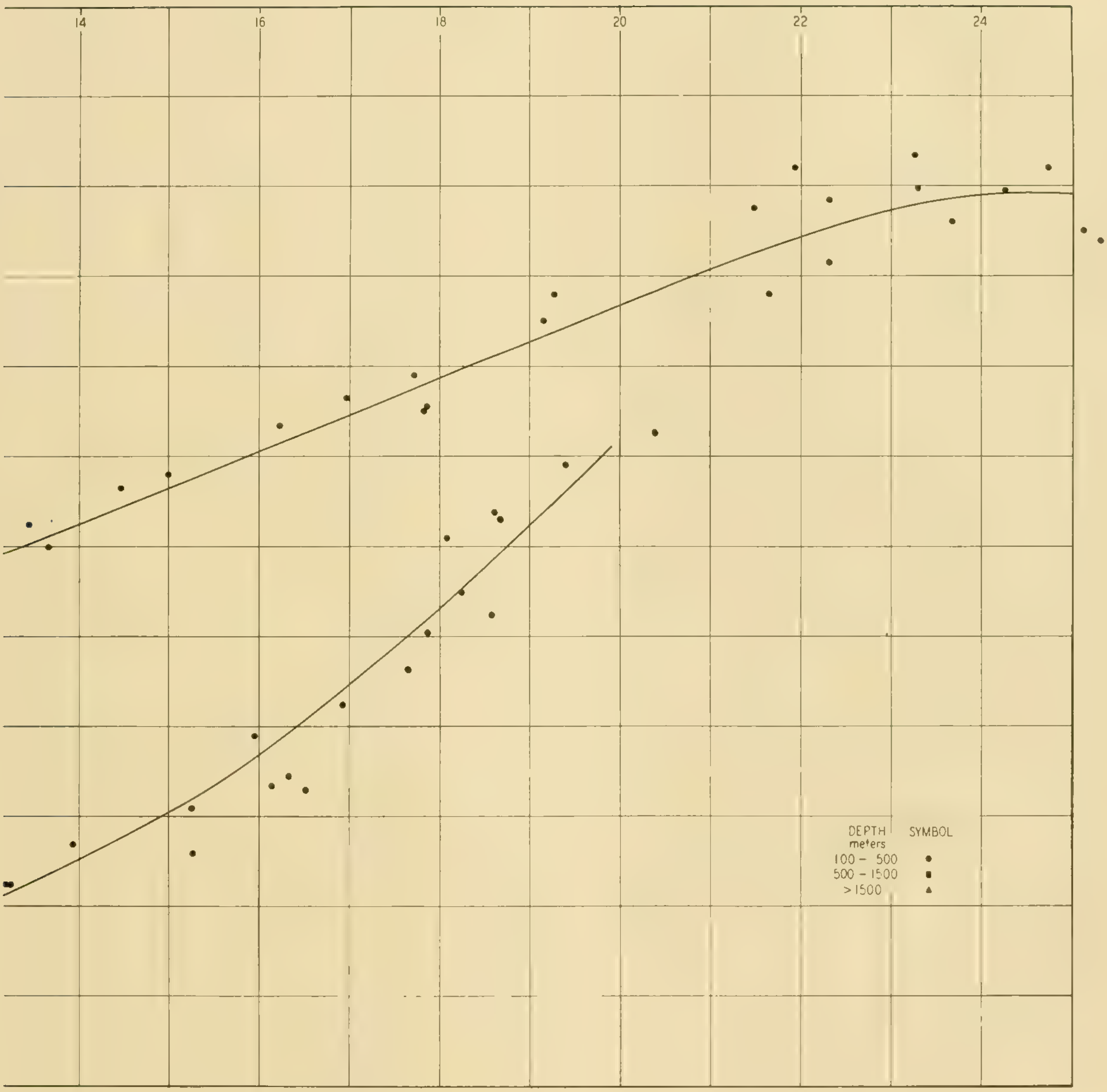


FIG. 16—COMPOSITE TEMPERATURE-SALINITY RELATION, REGIONS



7–9, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1929

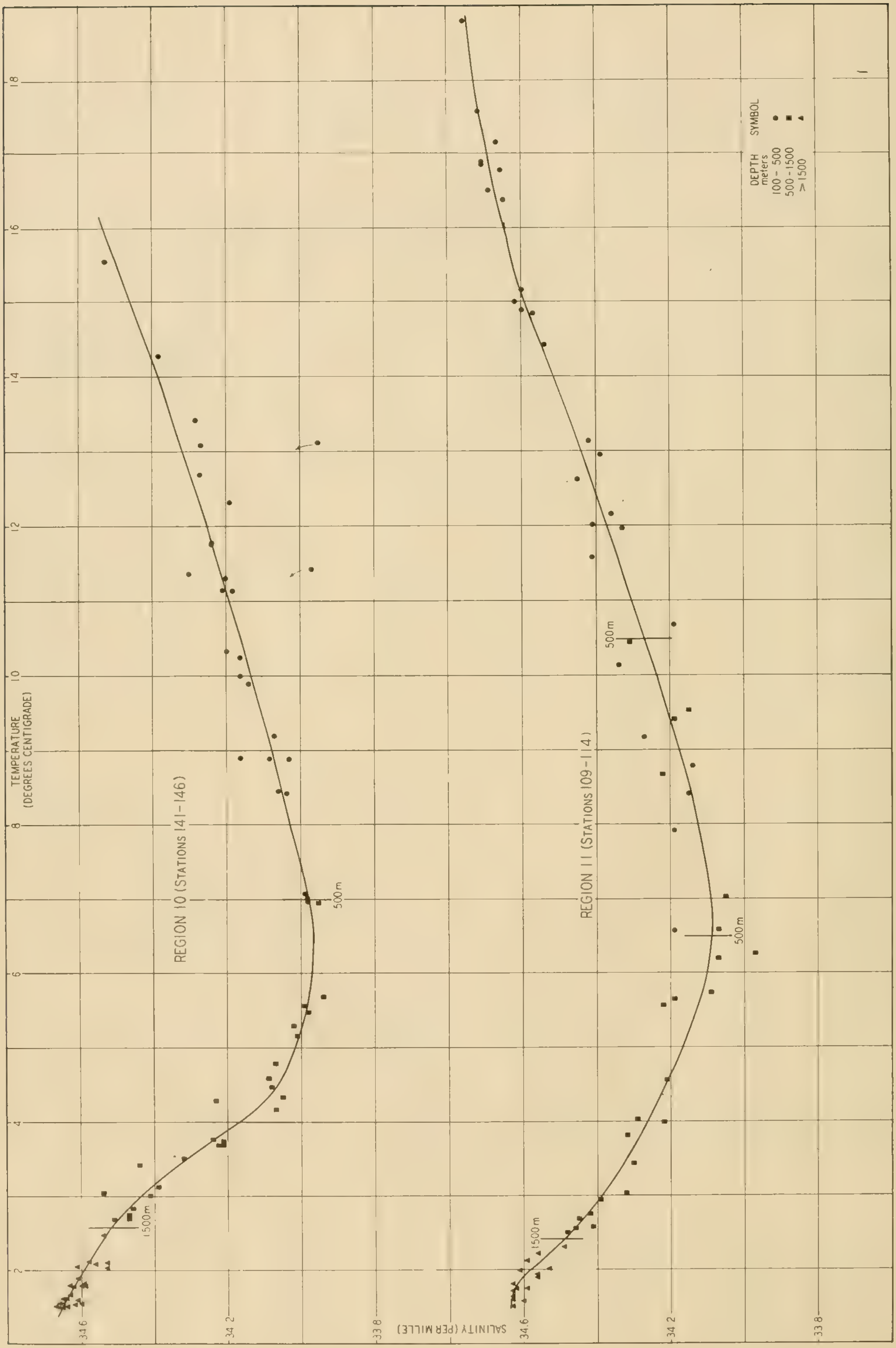


FIG. 17—COMPOSITE TEMPERATURE-SALINITY RELATION, REGIONS 10–11, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1929

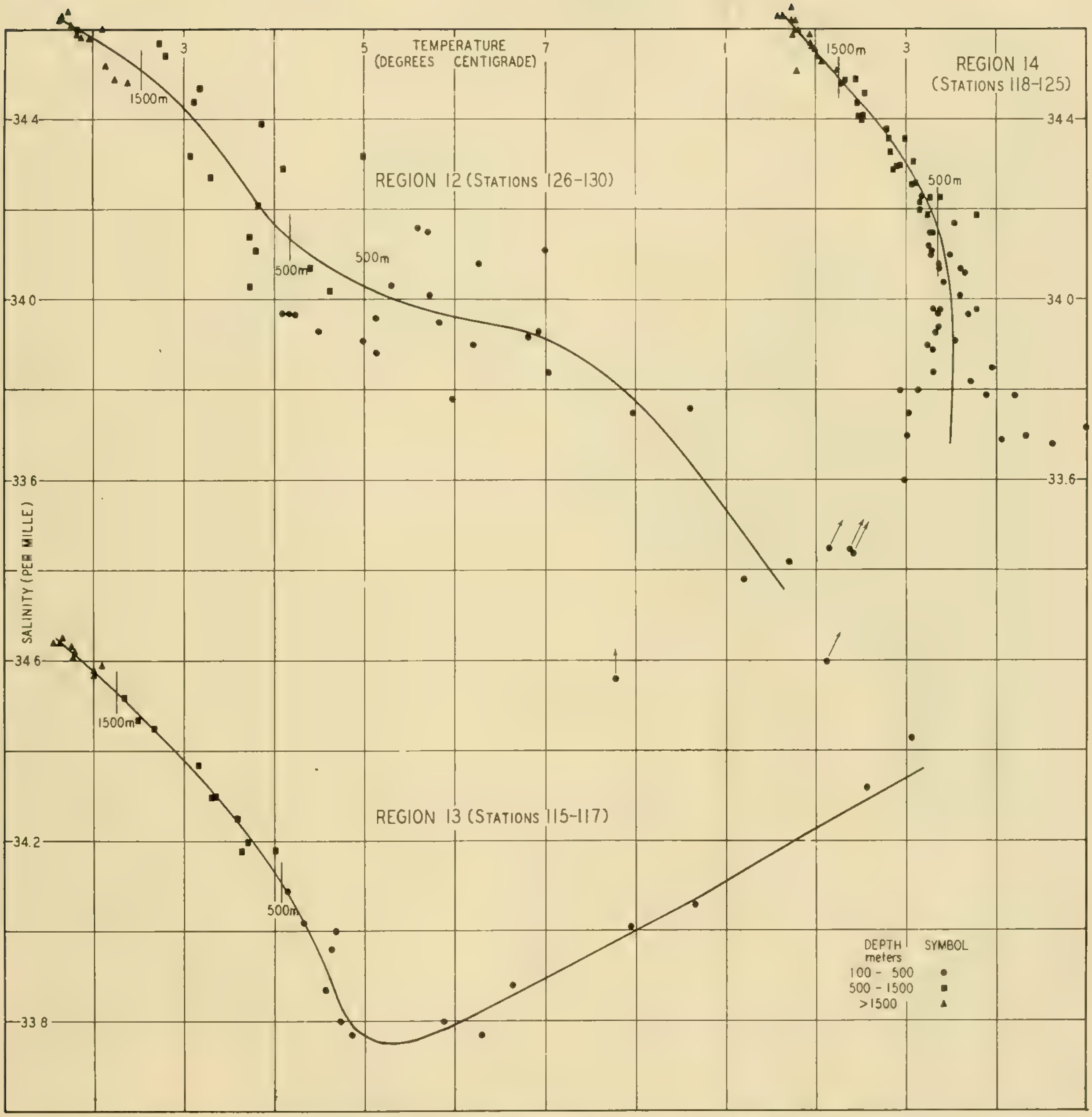


FIG. 18—COMPOSITE TEMPERATURE-SALINITY RELATION, REGIONS 12-14, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1929

FIG. 19—REGIONS WHERE TEMPERATURE-SALINITY RELATION IS NEARLY THE SAME IN EACH REGION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928–1929

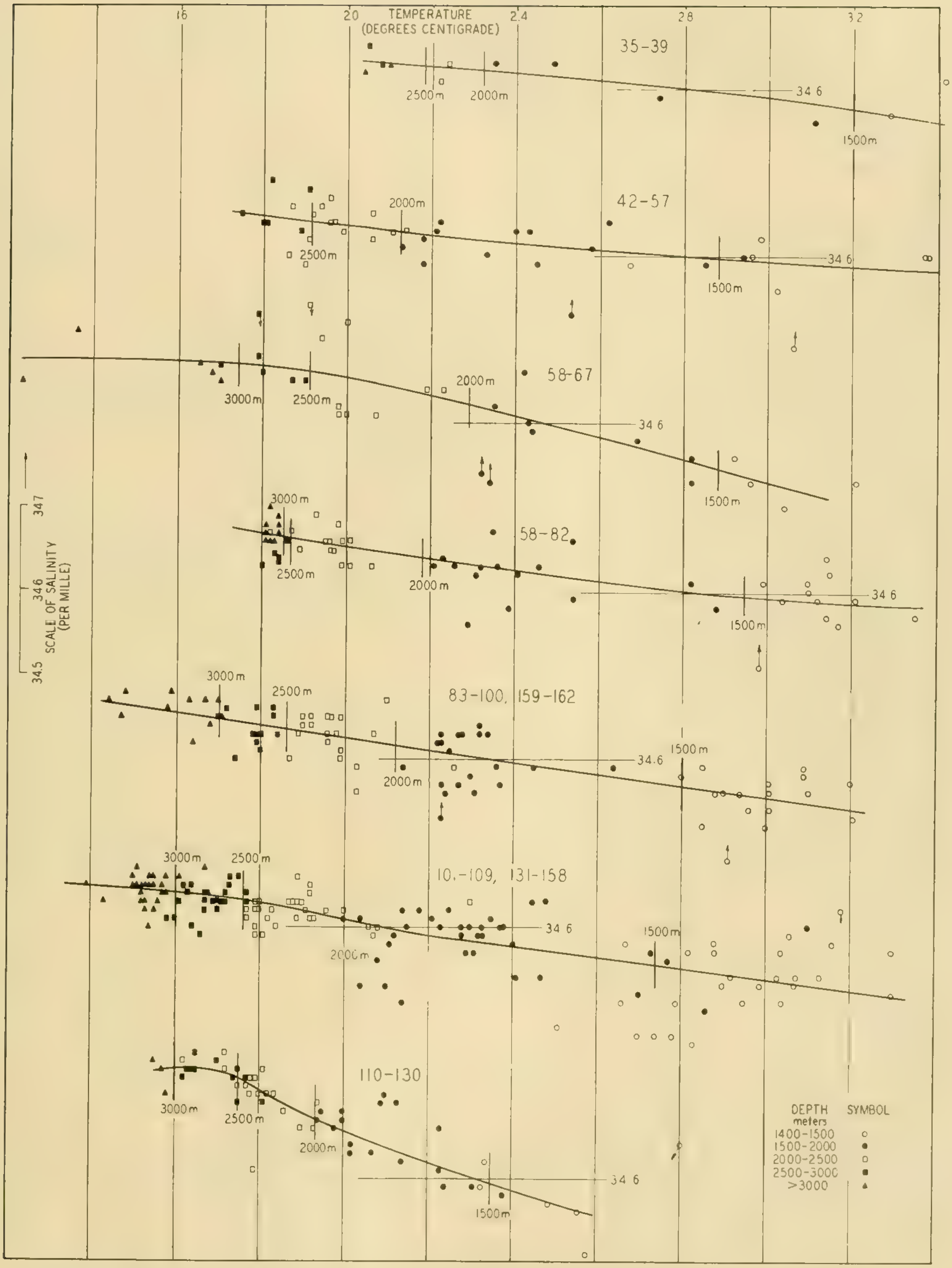


FIG. 20A—COMPOSITE TEMPERATURE-SALINITY RELATION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928-1929

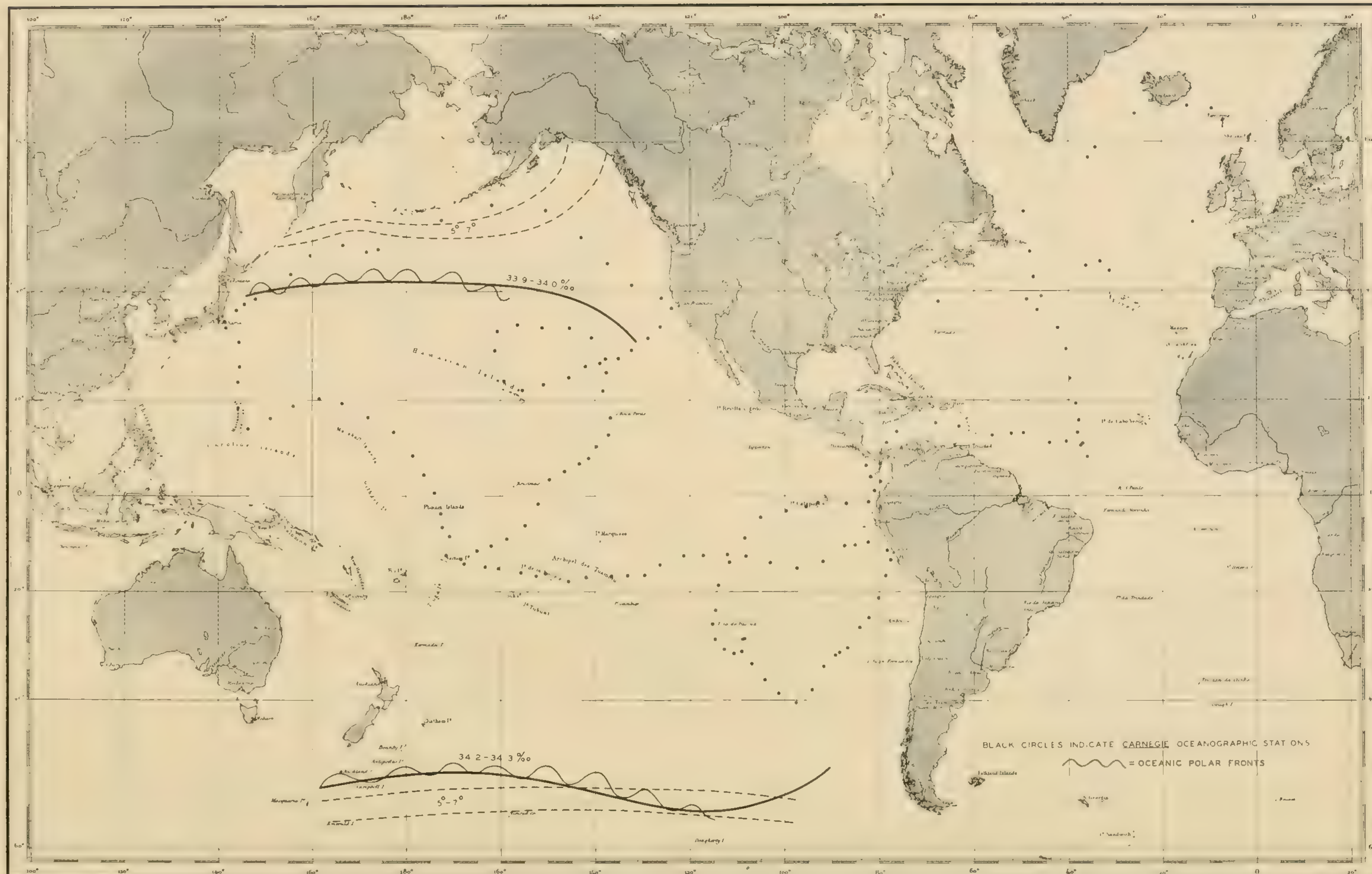


FIG. 20B—SURFACE TEMPERATURES AND SALINITIES CORRESPONDING TO CHARACTERISTIC VALUES OF INTERMEDIATE WATER IN BOTH HEMISPHERES

FIG. 21—BOTTOM TEMPERATURES OF WATER FOR BOTTOM DEPTHS GREATER THAN 3000 METERS, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1929

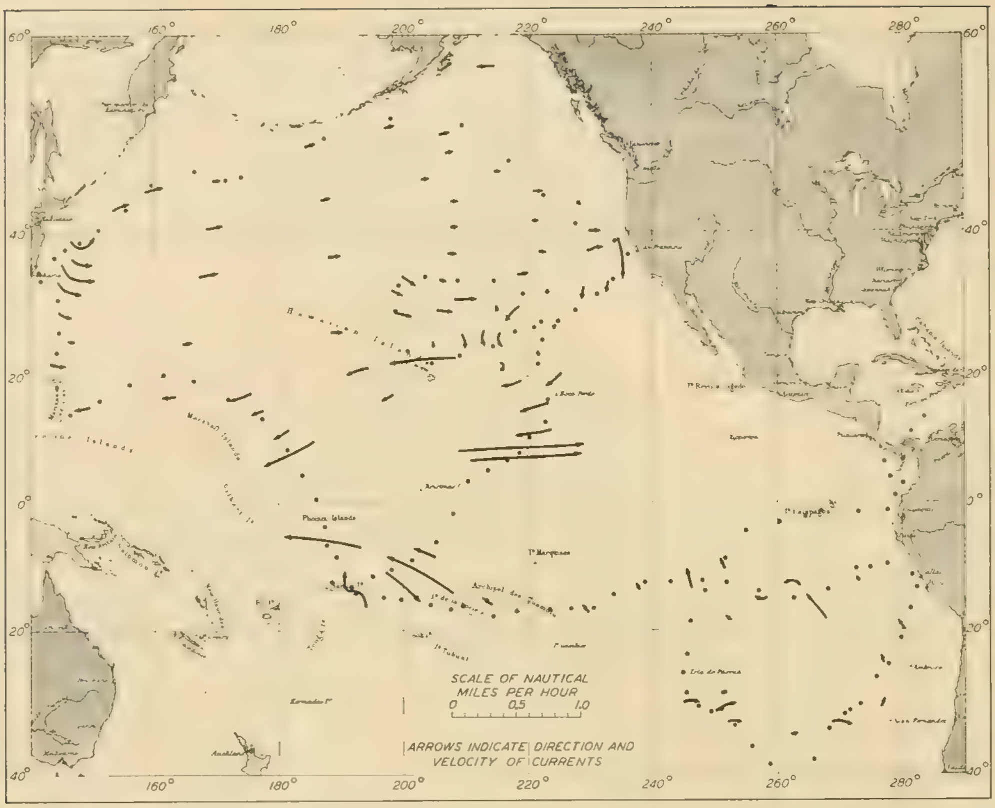


FIG. 22—CURRENT-CHART, PACIFIC OCEAN, FROM OBSERVATIONS OF SALINITY AND TEMPERATURE OF SEA WATER BY THE CARNEGIE, 1928–1929

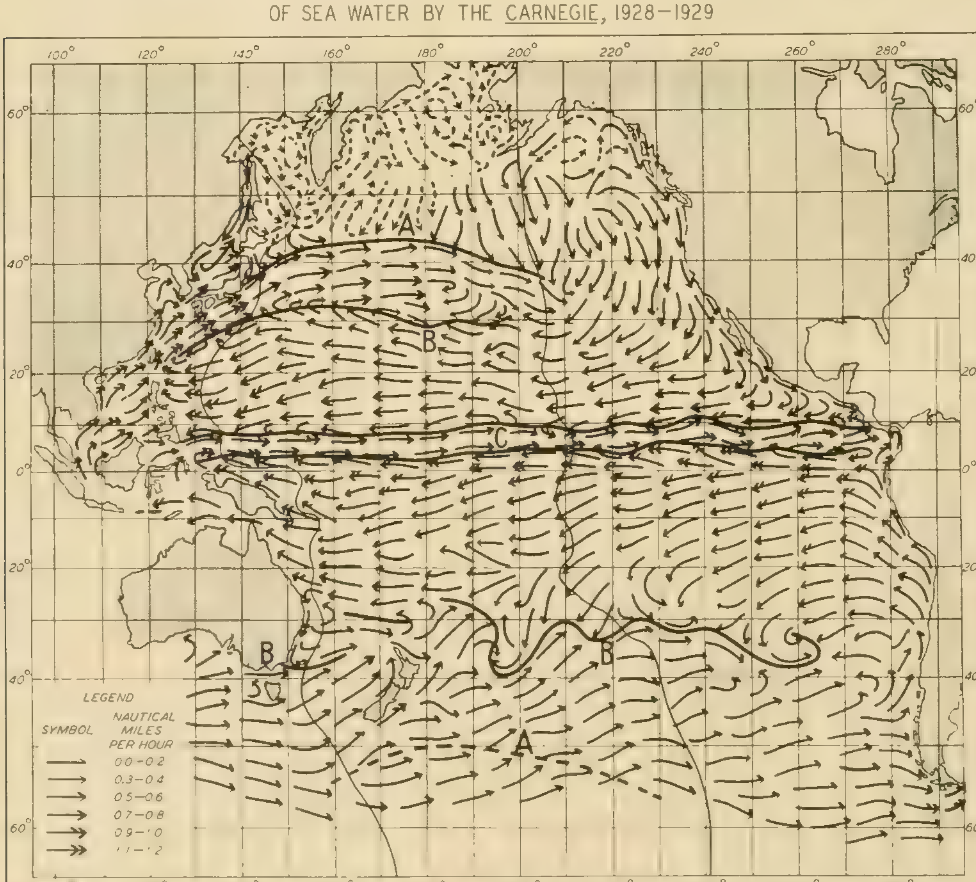


FIG. 23—PACIFIC CURRENTS IN NORTHERN SUMMER FROM PRELIMINARY SKETCH BY A. MERTZ
——— LONGITUDINAL CROSS-SECTION; ——A—— NORTHERLY POLAR FRONT; — —A— — SOUTHERNLY POLAR FRONT; ——B—— SUBTROPICAL CONVERGENCE; ——C—— LIMITS OF EQUATORIAL COUNTER-CURRENT

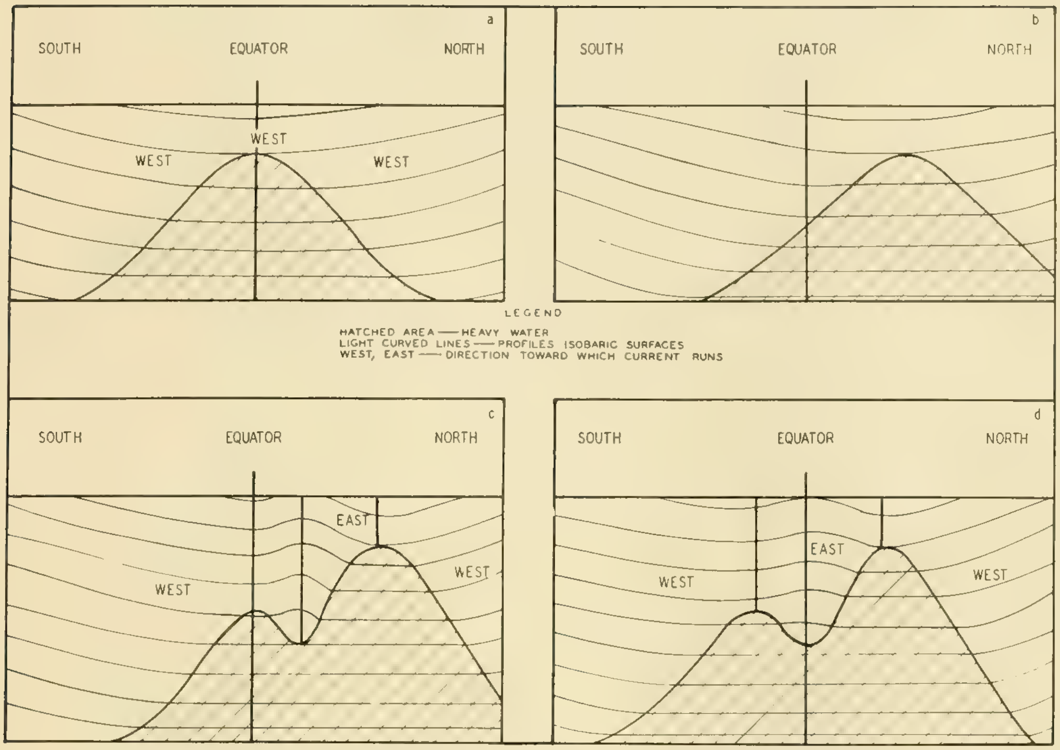


FIG. 24—SCHEMATIC REPRESENTATION POSSIBLE FIELDS DENSITY AND PRESSURE, VINCINITY OF EQUATOR, FROM CARNEGIE RESULTS, 1928–1929

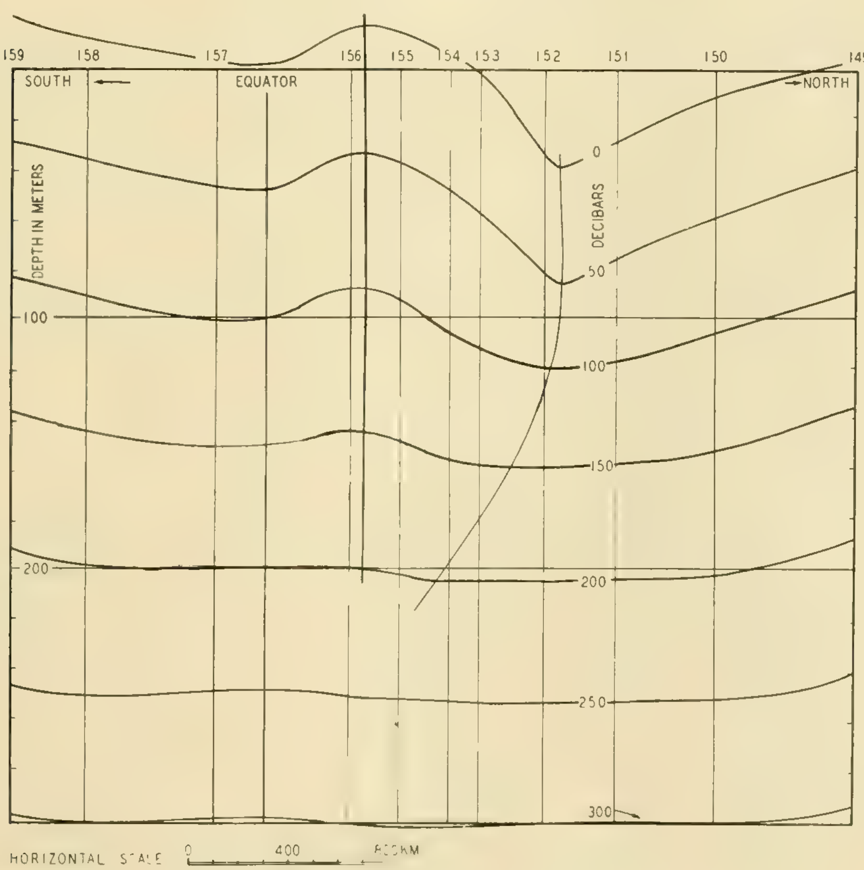


FIG. 25—PROFILE ISOBARIC SURFACES, FROM CARNEGIE RESULTS, 1929

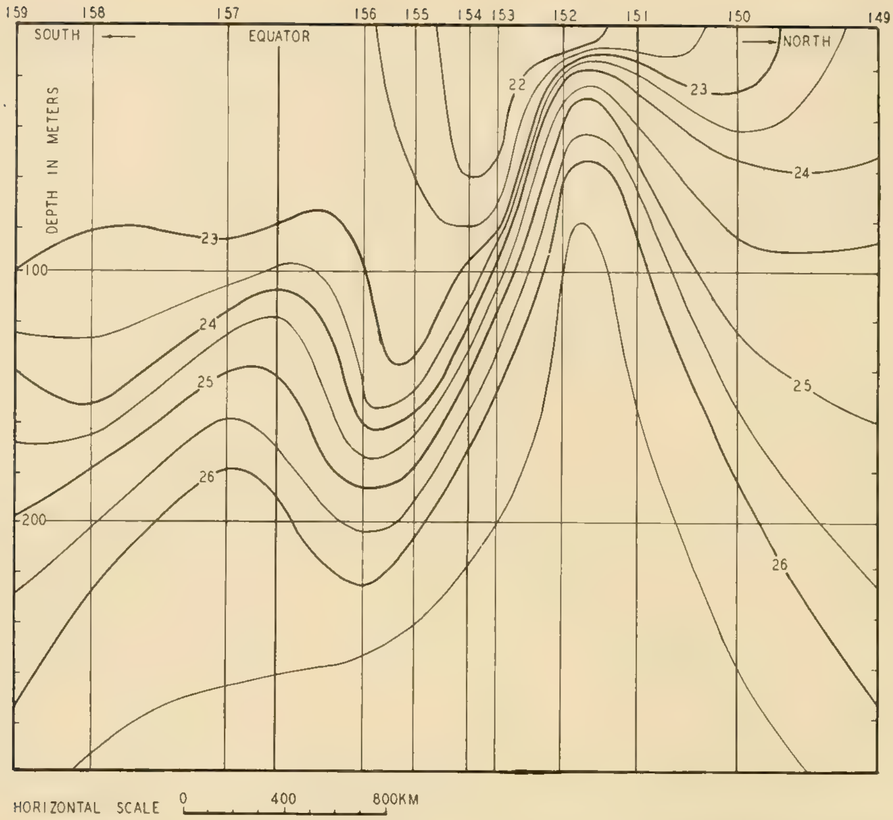


FIG. 26—VERTICAL DISTRIBUTION DENSITY, NORTH-SOUTH SECTION CROSSING EQUATOR, FROM CARNEGIE RESULTS, 1929

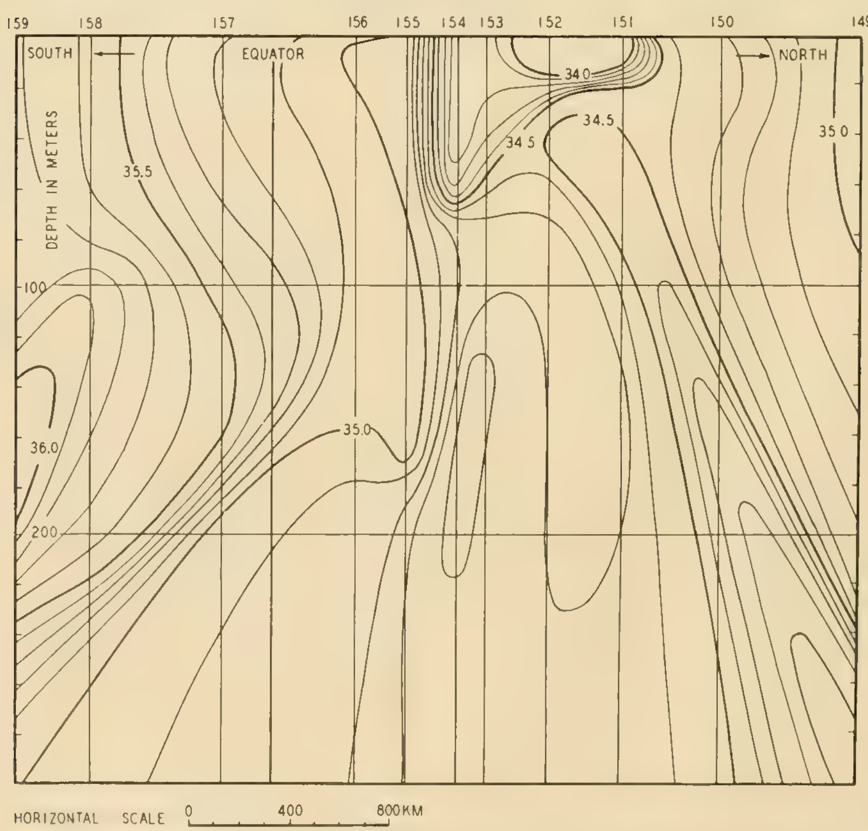


FIG 27—VERTICAL DISTRIBUTION SALINITY, NORTH-SOUTH SECTION CROSSING EQUATOR, FROM CARNEGIE RESULTS 1929

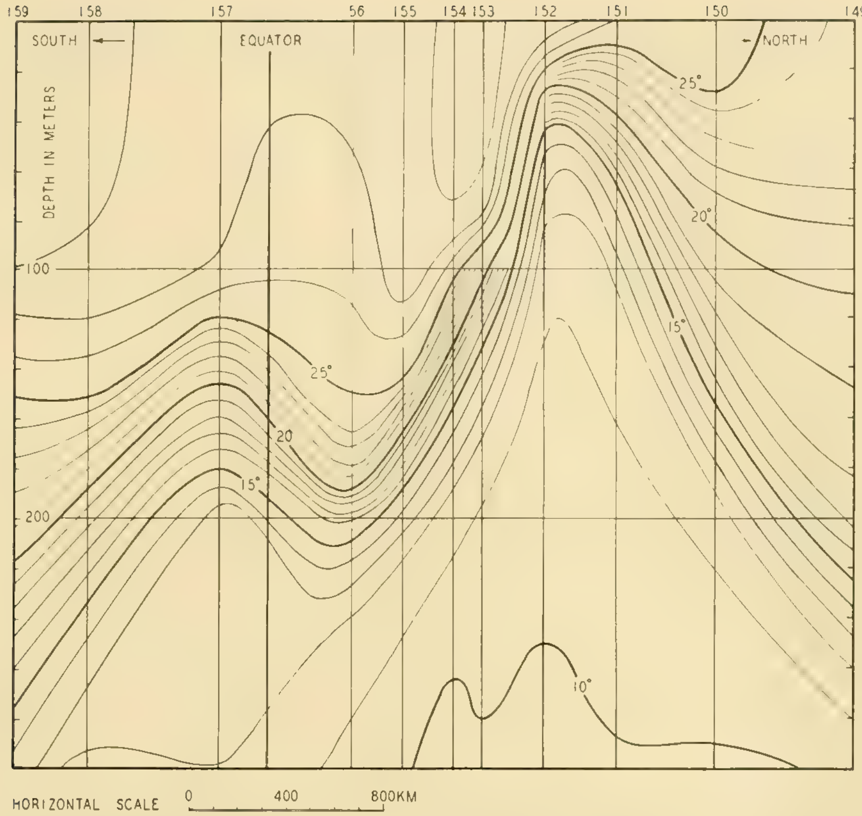


FIG 28—VERTICAL DISTRIBUTION TEMPERATURE, NORTH-SOUTH SECTION CROSSING EQUATOR, FROM *CARNEGIE* RESULTS, 1929

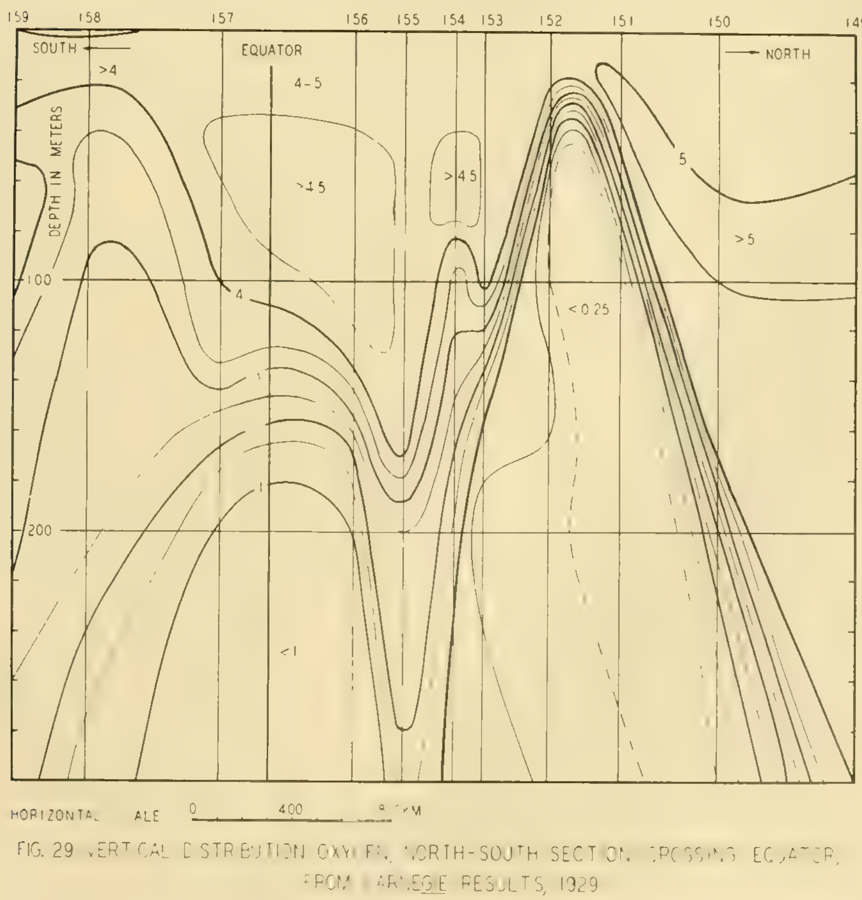


FIG. 29 VERTICAL DISTRIBUTION OXYGEN, NORTH-SOUTH SECTION CROSSING EQUATOR, FROM *CARNEGIE* RESULTS, 1929

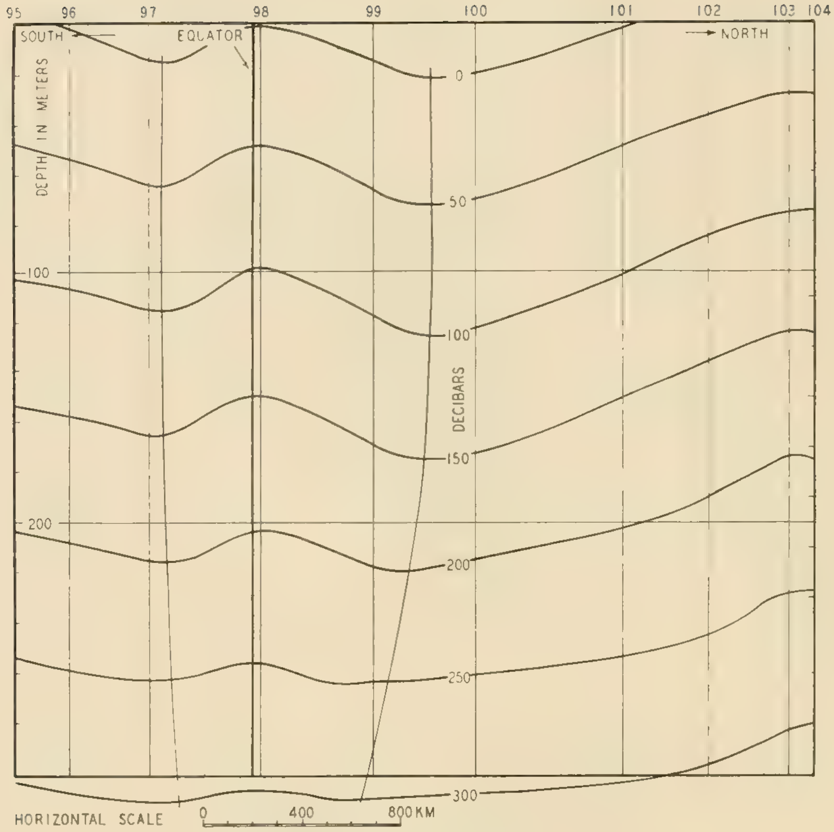


FIG. 30—PROFILE ISOBARIC SURFACES, FROM CARNEGIE RESULTS, 1929

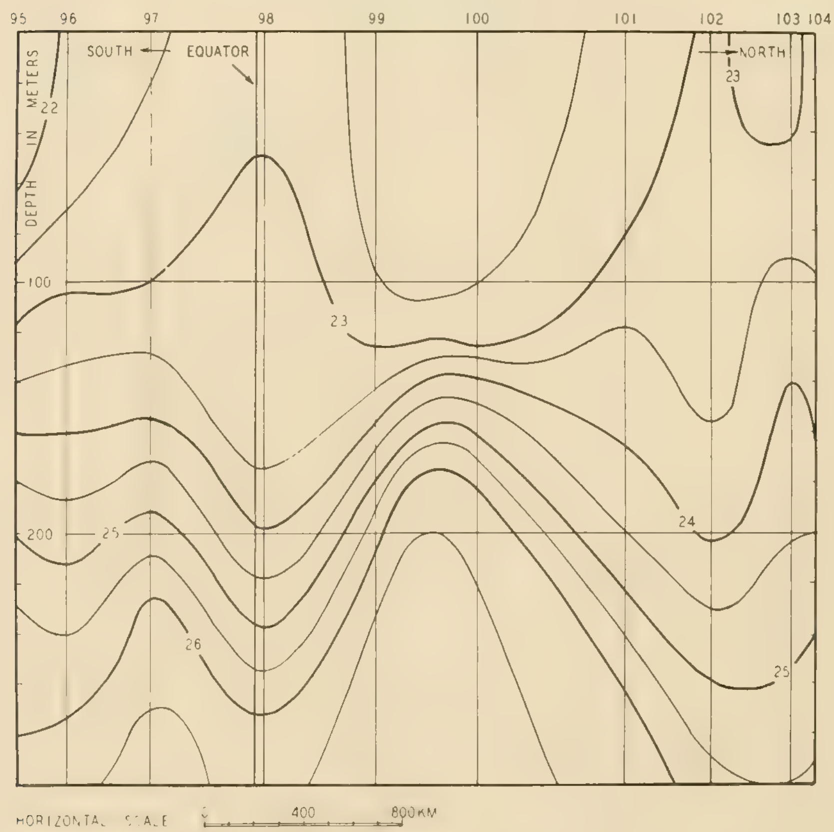


FIG. 31—VERTICAL DISTRIBUTION DENSITY, NORTH-SOUTH SECTION CROSSING EQUATOR, FROM CARNEGIE RESULTS, 1929

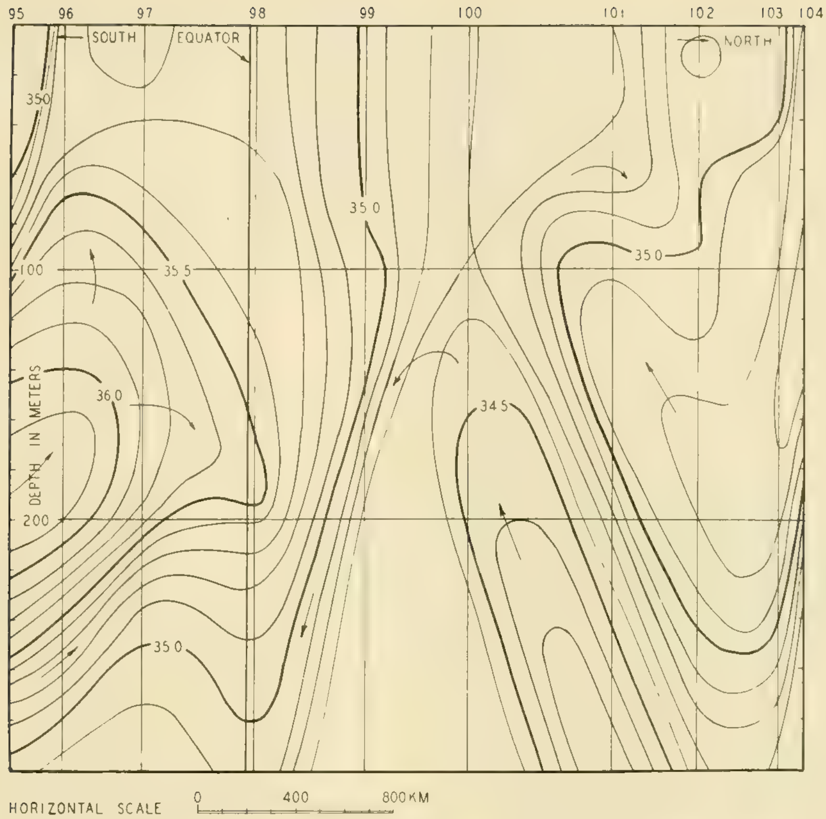


FIG. 32–VERTICAL DISTRIBUTION SALINITY, NORTH-SOUTH SECTION CROSSING EQUATOR, FROM CARNEGIE RESULTS, 1929

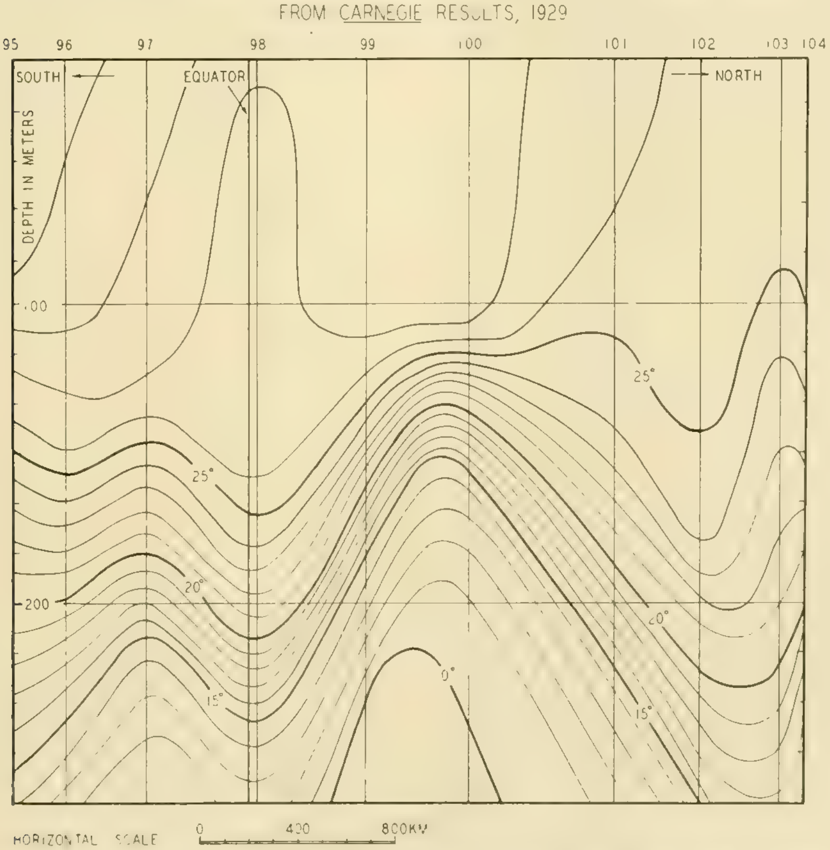


FIG. 33 –VERTICAL DISTRIBUTION TEMPERATURE, NORTH-SOUTH SECTION CROSSING EQUATOR, FROM CARNEGIE RESULTS, 1929

FIG. 34—CURRENT-CHART, PACIFIC OCEAN, AT SURFACE RELATIVE TO ASSUMED ZERO CURRENT AT 2000 METERS, FROM CARNEGIE RESULTS, 1928–1929

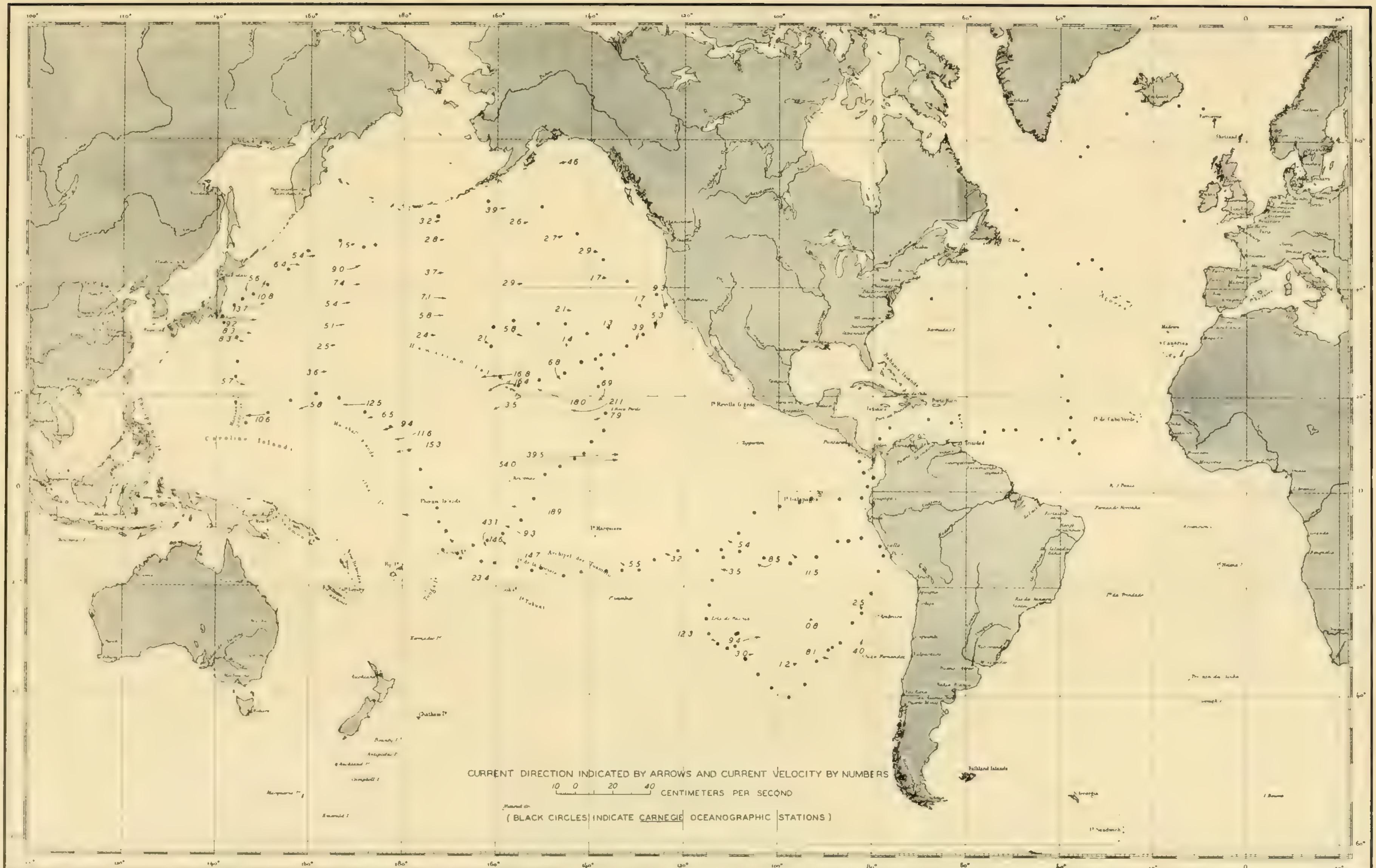


FIG. 35—CURRENT-CHART, PACIFIC OCEAN, AT 100 METERS RELATIVE TO ASSUMED ZERO CURRENT AT 2000 METERS, FROM CARNEGIE RESULTS, 1928-1929

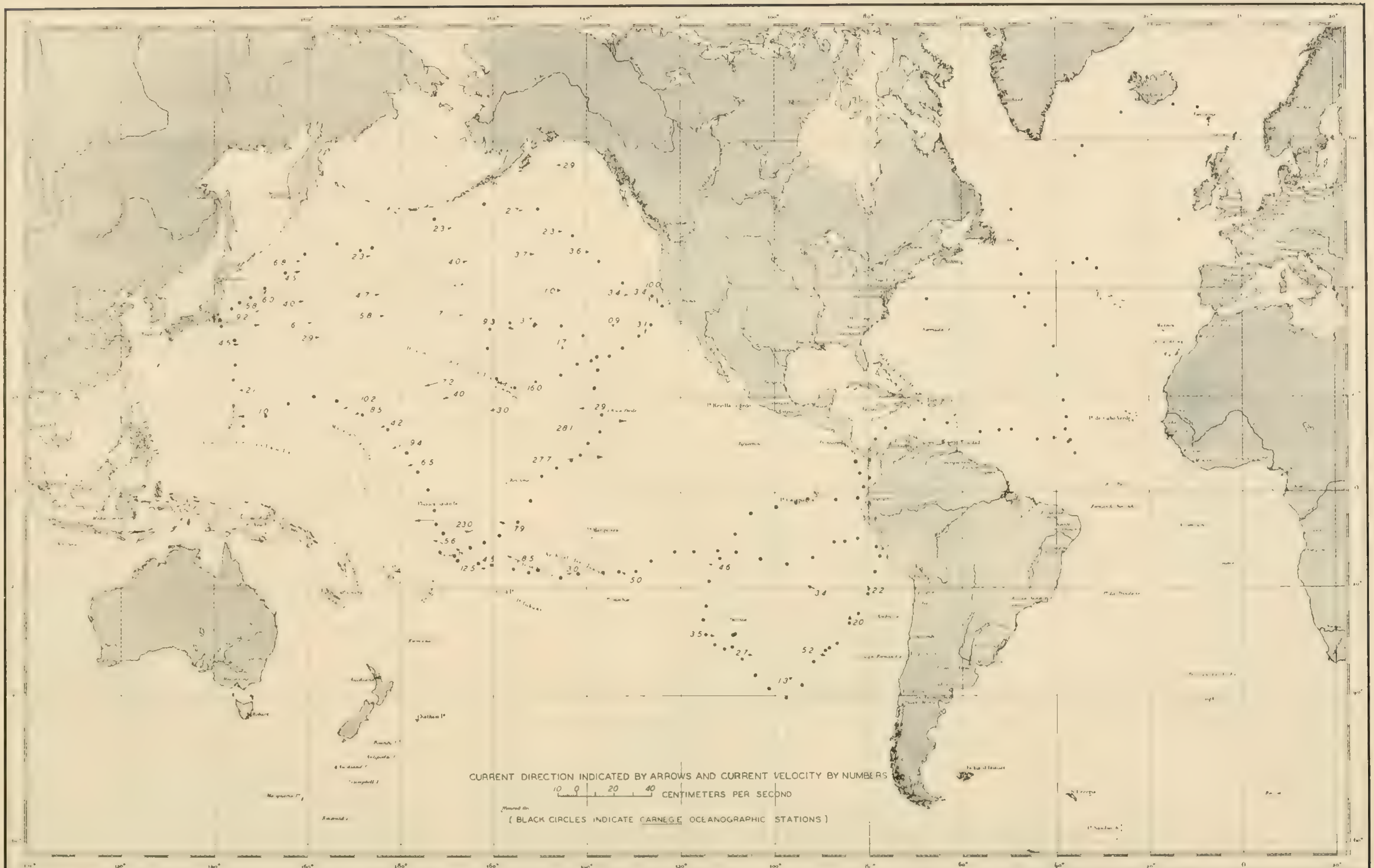


FIG. 36—CURRENT-CHART, PACIFIC OCEAN, AT 200 METERS RELATIVE TO ASSUMED ZERO CURRENT AT 2000 METERS, FROM *CARNEGIE* RESULTS, 1928-1929

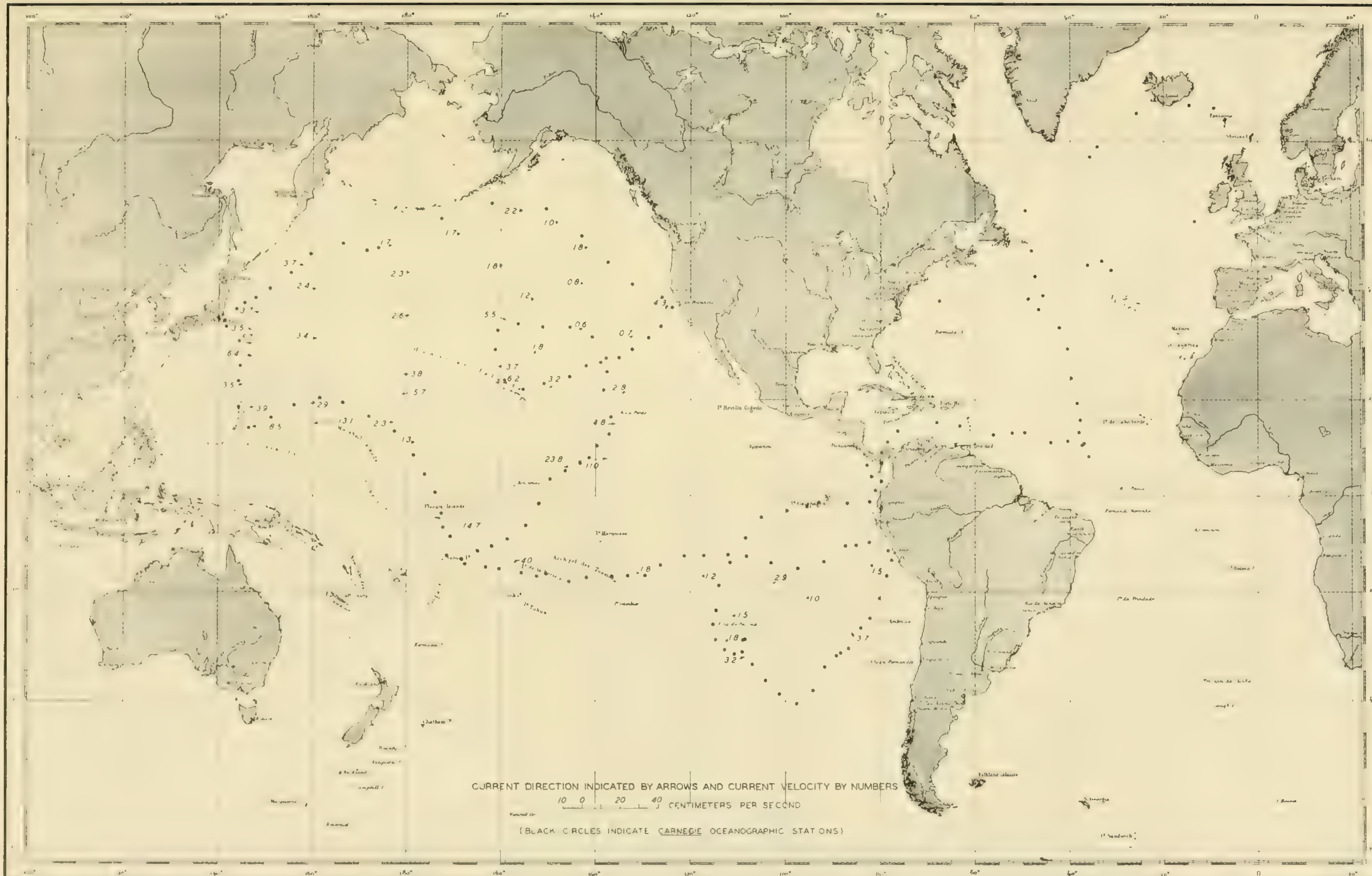


FIG. 37—CURRENT-CHART PACIFIC OCEAN, AT 400 METERS RELATIVE TO ASSUMED ZERO CURRENT AT 2000 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 38—CURRENT-CHART, PACIFIC OCEAN, AT 700 METERS RELATIVE TO ASSUMED ZERO CURRENT AT 2000 METERS, FROM CARNEGIE RESULTS, 1928-1929

The fact that the scientific program of the Carnegie did not permit of running parallel lines of soundings close together resulted in long single lines of soundings with few intersections. Consequently the data collected cannot be used alone for the construction of a bathymetric chart, but can be used to modify existing charts based on other data and in the construction of profiles along the course of the vessel. Such profiles reveal some of the major features of bottom relief and the general depth level of the oceanic sections traversed.

Attention may well be called to some of the features brought out on the profiles. On profile no. 8 is to be seen what has been named Merriam Ridge in about latitude 25° south and longitude 82° west. Its location with respect to the islands of San Felix and San Ambrosio makes it seem probable that a submarine ridge extends in a general northwest-southeast direction here, and that the two islands are the high points of the ridge.

On profile no. 9 at about latitude 15° south and longitude 98° west, Bauer Deep reaches a sharp depression of about 1500 meters below the nearby bottom. Farther to the west in this profile is the island of Tatakoto at about longitude 138° 20′ west. West of Tatakoto is Amanu Island at about longitude 140° 45′ west and westward of this we see a platform extending from about longitude 141° 40′ west to about 142° 30′ west. This is possibly a part of the platform on which rests the island of Tauere or St. Simeon, just to the north in about latitude 17° 20′ south. West of this platform in about latitude 18° south and longitude 145° west two soundings indicate the crossing of a ridge which is probably the extension to the southeastward of the base of Anaa or Chain Island. In about longitude 148° west is Mehetia Island with depths of more than 3000 meters between it and Tahiti. Farther to the west in the approach to the Samoan Islands, the base of Rose Island is discernible and a depth of more than 3500 meters separates the islands of Tutuila and Upolu.

In profile no. 11 the steep eastern and western approaches to Wake Island are seen at about longitude 166° 40′ east. From Wake Island westward to Guam the Carnegie traversed an ocean whose bottom was previously known to be very irregular and characterized by the submarine mountains such as appear in this part of the profile. Toward the western end of this profile the northern arm of Nero Deep was crossed in about longitude 147° 20′ east with soundings of 7846 and 7448 meters.

At about 24° north latitude in profile no. 12 we see Fleming Deep, in which the deepest of the Carnegie soundings were taken, namely, 8323 and 8347 meters. Soundings taken September 13 to 19, 1899, by the U.S.S. Nero about 30 miles west of the Carnegie positions hint at the existence of the deep but apparently were taken well up on the western slope. It seems probable that the Carnegie soundings also are west of the deepest part. A sounding of 7575 meters shown on Japanese Hydrographic chart no. 6080 at 23° 00′ north latitude, 144° 55′ east longitude, is probably on the southern border of this deep. Heavy weather (including two typhoons) produced so much extraneous noise in the hydrophones that it was impossible to take any soundings between about latitude 31° 40′ north and latitude 33° 20′ north. This was much lamented, as during this period our course lay across the southern, and what is probably the deepest, part of the extensive Tuscarora Deep. Farther north in this profile, between about latitude 36° north and 37° north, this deep was again crossed.

A newly discovered submarine mountain is shown in profile no. 13 at about latitude 46° 30′ north and longitude 169° 30′ east. It is rather broad, but rises from 1500 to 2000 meters above the surrounding ocean floor.

Between San Francisco and the Hawaiian Islands, and shown in profile no. 14 at about longitude 127° 50′ west, is a submarine mountain which has been named Hayes Peak. This mountain rises precipitously from depths greater than 4000 meters to within 1400 meters of the surface. The charts show a similar mountain about 20 miles WSW1/2W of Hayes Peak. This would suggest an error in position were it not probable that many such submarine mountains exist in this vicinity.

North of Honolulu, and shown in profile no. 16 at about latitude 25° 40′ north, is a rise which has been named Ault Peak. Although it was far from being completely explored, the shallowest sounding over it gave a depth of 2548 meters, indicating an elevation of more than 2000 meters above the neighboring ocean bottom.

In profile no. 21 the northeast and southwest approaches to Penrhyn Island are shown in about longitude 158° west. Similar approaches to Manahiki Island are shown in about longitude 161° west with the trough between the two islands reaching a depth of 5899 meters. Manahiki Island stands as a sharp peak on a broad platform the depth of which is between 2500 and 3000 meters; depths of more than 5000 meters separate it from the Samoan Islands.

Let us now consider how the soundings of the Carnegie require changes in our previous conceptions of the most probable course of the depth contours in the ocean areas traversed. Some base map must be selected for reference and, although it is not up to date in many respects, the Monaco "Carte Générale Bathymétrique des Océans" has been chosen as being most complete and most generally available to hydrographers. Reference is hereafter made to this chart with two exceptions, namely, the area between southern Greenland and Newfoundland, where the reader is referred to part 1 of the Scientific Results of "The Marion expedition to Davis Strait and Baffin Bay," Bulletin No 19, U. S. Treasury Department, Coast Guard, Washington, 1932, and in the region of the seas adjacent to Japan, where reference is made to the Japanese Hydrographic Department chart no. 6080.

On the Norwegian Sea slope and on the Iceland side of the saddle in the Faroe-Iceland Ridge, soundings 64 and 65 indicate that the 500-meter contour line should be moved somewhat to the northeast. On the southeastern coast of Iceland, between longitudes 15° and 17° west, the 1000-meter contour needs to be moved southward to include soundings 75 and 76. The tongue of the 1000-meter contour off Cape Reykjanes, Iceland, requires an S-shape on its western side to pass between sounding 99 and the group 100, 101, and 102. The adjacent 2000-meter contour southwest of here needs to be bent somewhat to the east to pass between soundings 107 and 108. Following this same contour toward the south, another S-pattern is embroidered on it, centered at about 58°

north latitude and 34° west longitude, by soundings 122, 123, 124, and 125. The adjacent 3000-meter line west of this is embayed toward the east to soundings 113 and 114, and passes between soundings 129 and 130. As the Carnegie soundings between southern Greenland and the Grand Banks were considered in the preparation of the bathymetric chart in "The Marion expedition to Davis Strait and Baffin Bay," Scientific Results, part 1, reference is made to that chart for this area.

Again referring to the Monaco chart, two soundings (nos. 21 and 23) of between 3000 and 4000 meters are located within the 4000-meter contour of the East Atlantic Depression. Whether these are isolated peaks or connect with the 3000- to 4000-meter bottom to the west and northwest is open to question. The northern part of the Azores Plateau apparently is more extensive than indicated on the chart, the 3000-meter contour on the eastern side extending to the northeastward to include soundings 19 and 20, and on the western side extending to the westward to include soundings 13 to 17 inclusive. Sounding 18 represents a new peak of the group near Chaucer Bank. Soundings 11 and 12, together with the now altered shape of the 3000-meter contour, make it seem probable that the 3000- to 4000-meter area between latitudes 42° and 44° north and between longitudes 37° and 38° west is connected with the continuous 3000- to 4000-meter belt along the western side of the Middle Atlantic Rise.

East of the southern tip of the Grand Banks the 4000-meter contour needs to be pushed somewhat to the eastward to include soundings 163, 164, and 165, and somewhat south of this, in about latitude 41° 30′ north, needs an indentation to exclude sounding 169. Still farther south between about latitudes 37° 30′ and 38° 30′ north, the 5000-meter line should be extended westward to conform to soundings 175, 7, 176, and 177. Then it is embayed eastward in the vicinity of the 37th parallel in consideration of soundings 178 to 183 inclusive. Soundings 184 to 189 inclusive indicate that this 4000- to 5000-meter arm is connected by means of a low ridge to the general 4000- to 5000-meter belt along the western side of the Middle Atlantic Rise. This leaves an isolated depression of more than 5000 meters depth running northeastward from the ridge just mentioned. As one approaches the Dolphin Plateau from the northwest, the 4000-meter line should be moved somewhat westward to pass between soundings 190 and 191; the 3000-meter contour either cuts the plateau into two sections or is deeply embayed on each side to conform to soundings 197 and 198.

On the eastern slope of the Middle Atlantic Rise in this vicinity, the 4000-meter line is extended sharply southward by soundings 201 to 204 inclusive. Sounding 206 moves the 5000-meter contour eastward. Sounding 208 may either represent an isolated pool or a narrow valley communicating with Moseley Deep. The embayment demanded just south of here by soundings 211 and 213 lend favor to the valley idea. Farther south in about latitudes 15° to 16° north, soundings 220, 221, and 225 may again require the considerable invasion of the Moseley Deep by the 5000-meter contour or they may be isolated elevations. Still farther south in about latitudes 10° to 12° north, this same 5000-meter line takes on a very complicated pattern with a general displacement to the southwestward by soundings 231 to 234 inclusive and 243 to 249 inclusive. Because of lack of data it is difficult to state on which side of the Middle Atlantic Rise sounding 238 is located, but in either case one of the 4000-meter lines must be altered to accomodate it.

Between about latitudes 11° and 12° north the 4000-meter line on the eastern side of the Middle Atlantic Rise takes on an S-pattern to conform to soundings 253 to 257 inclusive. Crossing the rise at this latitude a 3000-meter contour is required to encircle soundings 261 and 262. The 4000-meter line is extended in a spur to the westward; the isolated area deeper than 5000 meters just to the south of this spur is greatly diminished.

Near here, the southeastern corner of the 5000-meter contour of the West Atlantic Depression is embayed to the eastward so as to pass between soundings 270 and 271, the northern boundary of the embayment following more or less the line of soundings 271 to 282 inclusive. Just east of Barbados the 3000-meter contour line should be moved northward to include soundings 300 to 302 inclusive.

In the Caribbean Sea south of Porto Rico, sounding 315 apparently indicates an isolated peak which must be encircled by a 4000-meter contour. Farther to the west between Haiti and western Venezuela and about midway between them, soundings 318 and 319 indicate the presence of a rise which must be encircled by a 4000-meter contour.

In the southeastern Pacific one of the most important revelations of the Carnegie soundings is that the threshold level of the Easter Island Rise is of a depth less than 3000 meters from about latitudes 9° to 39° south. The 3000-meter contour on the western side of the rise extends in a general northerly direction from about latitude 39° south and longitude 113° west to about latitude 15° south and longitude 115° west, and thence northeastward to about latitude 9° south and longitude 108° west. From this point it curves southward, along the eastern side of the rise, concave toward the east, passing close to the northern side of Easter Island, then extending to the east to include the rocks of Sala y Gomez, then following an irregular course to about latitude 36° south and longitude 104° 30′ west, and then southwestward to close the area. These surmises are based on soundings 373 to 421 inclusive and 543 to 547 inclusive combined with the chart values.

Soundings 424 to 429 inclusive indicate that the embayed 4000-meter line to the south of the Easter Island Rise at about longitude 100° west does not come as far north as has been supposed. Merriam Ridge, disclosed by soundings 458 to 461 inclusive, seems probably to be an extension to the northwest of the base on which rest the islands of San Felix and San Ambrosio. Just north of Merriam Ridge, soundings 463 and 464 require that the 4000-meter contour be moved somewhat to the south; soundings 468 to 471 seem to show that the isolated area of between 3000 and 4000 meters depth is larger than that shown on the chart as a narrow strip between about latitude 17° south and longtiude 75° 30′ west and about latitude 15° south and longitude 77° west.

Soundings 481 and 482 show that the 5000-meter contour of the Milne-Edwards Trench extends farther to the northwest. The 4000-meter line on the eastern side of the Easter Island Rise apparently follows the course of the Carnegie from about longitude 92° west to about longitude 105° west, weaving in and out among soundings 505 to 534 inclusive, with Bauer Deep at sounding 519 as a narrow deep bay.

The caldron in the Easter Island Rise, shown on the

chart between about latitudes 3° and 9° south and about longitudes 100° and 104° west, is modified by soundings 366 to 369 inclusive.

Malpelo Island is shown on the chart as resting on a platform of less than 3000 meter depth, which is connected to the South American continent. Soundings 340, and 343 to 346 inclusive, however, indicate that this platform is separated from the continent by a channel greater than 3000 meters in depth and having a small but deep depression in its middle (sounding 344).

On the western side of the Easter Island Rise soundings 577 to 601 inclusive require that the 4000-meter contour line extend in a long tongue as far west as longitude 131° west in about latitude 17° south.

In the Tuamotu Archipelago soundings 620 to 662 indicate that the 4000-meter line surrounding the northern group includes the islands of Angatau, Fakaina, Rekareka, Taueri, Tatakoto, Pukaruha, and Reao, were it not for the single old sounding of 4000 meters at latitude 18° 08′ south, longitude 141° 49′ west. Soundings 668 and 669 show that the base of Anaa Island extends to the southeastward. In the Society Islands soundings 687 and 688 of more than 3000 meters separate Morea from Husheine; soundings 699 and 700 may mean that a channel deeper than 4000 meters separates Bellingshausen, Scilly, and Mopelia from the rest of the group. West of of Tahiti and south of Raiatea the 4000-meter line needs to be moved south to conform to soundings 694 and 695.

West of the Society Islands in about latitude 16° south the 5000-meter contour is more deeply embayed to the east, as is shown by soundings 712 to 723 inclusive. Following westward along the north side of this bay, this contour continues until about the position of sounding 731 and thence northward nearly to Nassau Island to pass between soundings 1482 and 1483. Northeastward of Danger, Nassau, and Suwarrow islands lies the large submarine platform on which stand the islands of Manahiki and Ryerson. A 4000-meter contour line apparently surrounds this entire area, and a sizable area within this is enclosed in a 3000-meter line (soundings 1458 to 1480 inclusive). Soundings 1452 to 1455 inclusive show a trench of more than 5000 meters between Manahiki and Penrhyn islands.

East of Starbuck Island soundings 1423 to 1426 show the 5000-meter line to be embayed somewhat to the north; depths between Malden Island and Filippo Bank are greater than 4000 meters. At sounding 1415 the bottom is elevated about 800 meters above the neighboring floor.

Between about longitudes 149° and 160° west, the chart shows a 5000-meter contour running in an east-west direction just north of the equator. The chart also shows a 5000-meter line surrounding Christmas, Fanning, Washington, and Palmyra islands. The paucity of soundings southeast of Fanning Island leaves much to conjecture, yet in view of soundings 1389 to 1410 inclusive it seems likely that this area is all of depth less than 5000 meters and that the 5000-meter line runs from a point just west of Jarvis Island northward to meet the chart line at about latitude 2° north, longitude 160° west, that it then follows the course on the chart around the islands mentioned as far as about latitude 7° north, longitude 156° 30′ west, whence it follows the 7th parallel eastward to again join the chart line northward near longitude 149° west. This must remain a conjecture until more data are at hand. Soundings 1403 to 1408 inclusive indicate that a small closed 4000-meter contour is required in this vicinity.

A 5000-meter contour line apparently follows the course of the Carnegie from soundings 1332 to 1396, threading in and out among the soundings. This would indicate two things, namely, that an extensive arm thrusts southwestward from what is shown as a caldron centered about 11° north latitude and 130° west longitude, and that the supposed caldron is in communication with and is not shut off from the 5000- to 6000-meter depths of the North Pacific Basin.

Between about longitudes 138° and 144° west an east-west 5000-meter contour is shown between latitudes 24° and 25° north. This needs to be moved farther south to conform to soundings 1314 to 1319 inclusive and 1190 to 1193 inclusive. This same 5000-meter contour farther north, in about latitude 30° 30′ north and longitude 140° west, must be extended northward in view of soundings 1289 to 1292 inclusive.

A sounding (no. 1282) of less than 5000 meters appears at longitude 145° west and a sounding of more than 6000 meters (no. 1250) appears northwest of Murray Deep. The 5000-meter line north of the Hawaiian Islands probably extends northwestward as far as about latitude 28° 30′ north and about longitude 161° west (soundings 1229 to 1238 inclusive). From this base Ault Peak (sounding 1231) rises to a depth of 2548 meters.

The Hawaiian, Gilbert, and Marshall groups are all shown as having a common base of less than 5000 meters depth. The southern part of this 5000-meter contour line is shown on the chart as being just south of the equator and just north of the Phoenix group. Soundings 798 to 824 inclusive seem to indicate that the 5000-meter line is deeply embayed northwestward with a deeper area between the Gilbert and Marshall groups to the southwest and the Hawaiian group to the northeast. The southern part of the 5000-meter line around the Hawaiian group is apparently moved northward to about latitude 3° north to pass between soundings 807 and 808, thence northwestward and returning north between soundings 815 and 816. The line probably continues to the north to connect with what is shown on the chart as a closed depression of more than 5000 meters in the neighborhood of latitude 20° north, longitude 175° west. From the western end of this supposed depression, the 5000-meter line probably continues southwestward, joining the chart line at about latitude 19° north, longitude 178° east. Soundings 839 and 841 seem to show that a low ridge connects this western end of the Hawaiian Rise with the Marshall base near Taongui Island--the northermost of the Marshall group. A small area enclosed by a 6000-meter contour is required by soundings 823 and 824; a 4000-meter line must surround sounding 814. Soundings 830 to 833 indicate another small uncharted rise.

We find from soundings 849 to 859 inclusive that the 5000-meter line surrounding Wake Island extends much farther to the southeast of the island than to the northwest.

Referring now to Japanese Hydrographic Department Chart No. 6080, Carnegie soundings 865 to 873 inclusive introduce new contour patterns around the submarine mountains at about latitudes 20° to 22° north and longitudes 162° to 162° east. Additional newly found peaks in this submarine range between this locality and Nero Deep are shown by soundings 883, 896, and 900. On the western border of Nero Deep east of Rota Island, soundings 906 and 907 require the 5000- and 6000-meter lines to be moved more to the eastward.

Soundings 934 and 935 require the introduction in Fleming Deep of an 8000-meter contour, and the extension of the 6000- and 7000-meter lines in this vicinity. South of Fleming Deep sounding 930 shows an isolated peak, and to the north of Fleming Deep another isolated peak is evidenced by sounding 944.

Near the southern end of Tuscarora Deep the eastern 6000-meter line must be moved somewhat more to the east to conform to soundings 948 and 949, whereas farther north sounding 959, on the western slope of the deep, requires the 7000-meter line to be moved to the eastward. East of Tokio soundings 965 and 966 show that the 2000-meter contour and probably the 3000-meter line need to be moved eastward.

Somewhat farther north and on the eastern slope of Tuscarora Deep, soundings 972 to 977 inclusive introduce an S-shaped irregularity into both the 6000- and 7000-meter lines and diminish the area enclosed in the 8000-meter contour.

Soundings 1021 to 1048 inclusive, of which nos. 1022, 1026, 1027, 1032, 1033, 1043, and 1047 are greater than 6000 meters, suggest that a 6000-meter contour runs along the 47th parallel from about longitudes 165° to 175° east, and that this represents the southern boundary of a connection between the Kamchatka Trench and the Aleutian Deep. Soundings taken by the U. S. S. Ramapo have been published by the U. S. Hydrographic Office in a "List of oceanic depths 1931, North Pacific Ocean," H. O. no. 210a, Washington, 1932. Soundings listed in this publication as "route no. 8," on pages 4 to 12 inclusive, parallel the route of the Carnegie somewhat to the southward between Japan and San Francisco. As published, they are based on a constant sounding velocity of 1463 meters per second. Those soundings between latitude 34° 01′ north, longitude 140° 41′ east, and San Francisco have been corrected for sounding velocity according to the Carnegie data. Comparing these soundings with the Carnegie soundings, there seems to be a low rise on the seaward side of Tuscarora Deep, Kamchatka Trench, and Aleutian Deep, separating these from the deep basin of the North Pacific. A submarine mountain on this rise is disclosed by soundings 1029, 1030, and 1031, with another such mountain indicated by sounding 1038.

Referring once more to the Monaco chart, it would seem from soundings 1050 to 1062 inclusive, of which nos. 1050, 1061, and 1062 are less than 5000 meters, that the 5000-meter contour borders the southern part of the Aleutian Deep as far westward as about longitude 177° west before it turns southeastward.

One other notable departure from conditions indicated on the charts has yet to be considered. This is a wire sounding of 1344 ± 40 meters at oceanographic station 40 in latitude 1° 32′ south and longitude 82° 16′ west. This was named Carnegie Ridge, but in the absence of other soundings we can only remark that it occurs in an area where the chart shows a depth of between 3000 and 4000 meters.

The names "Carnegie Ridge," "Merriam Ridge," "Bauer Deep," "Fleming Deep," and "Hayes Peak," assigned by Captain J. P. Ault to these various features at the time of their discovery, have been retained in this discussion along with the name "Ault Peak," which was christened after Captain Ault's death.

Some of the profiles of approach to land in the Pacific are shown in the accompanying diagram (fig. 1). These are all islands and are, therefore, shown along with the maximum slope which is theoretically stable according to Littlehales (Bull. Nat. Res. Council, no. 17, pp. 90-93, 1922). Inasmuch as some of these islands have an appreciable mass above the water level, a strict comparison is not justifiable. In order to better compare the actual bottom slopes, all the curves have been started from the shore line and the distance of the center of the peak from the shore line has been given in tabular form to enable the reader to differentiate between the large and small islands. Of the nine islands, the approaches for which are shown, four are grouped as large and five as small. An interesting feature which offers food for thought is that four of the five small islands shown have a secondary ridge or elevated prominence on their northeastern sides, whereas the fifth (Wake Island) was not approached from this direction. In the case of Penrhyn Island, this ridge apparently comes very close to the surface and is known as Flying Venus Reef. The data are, of course, too meager for conclusions, and the absence of similar ridges on the other sides of these islands, as indicated by the Carnegie soundings, may be owing to too great an interval between soundings, rather than to the actual nonexistence of such irregularities. In the case of Amanu Island, the apparent irregularity may not be real and may only be the result of the devious path of approach.

These findings, as well as the entire sounding program of the Carnegie, stress the need of more thorough exploration of the ocean depths and impress one with the inadequacy of our present knowledge of the bottom features.

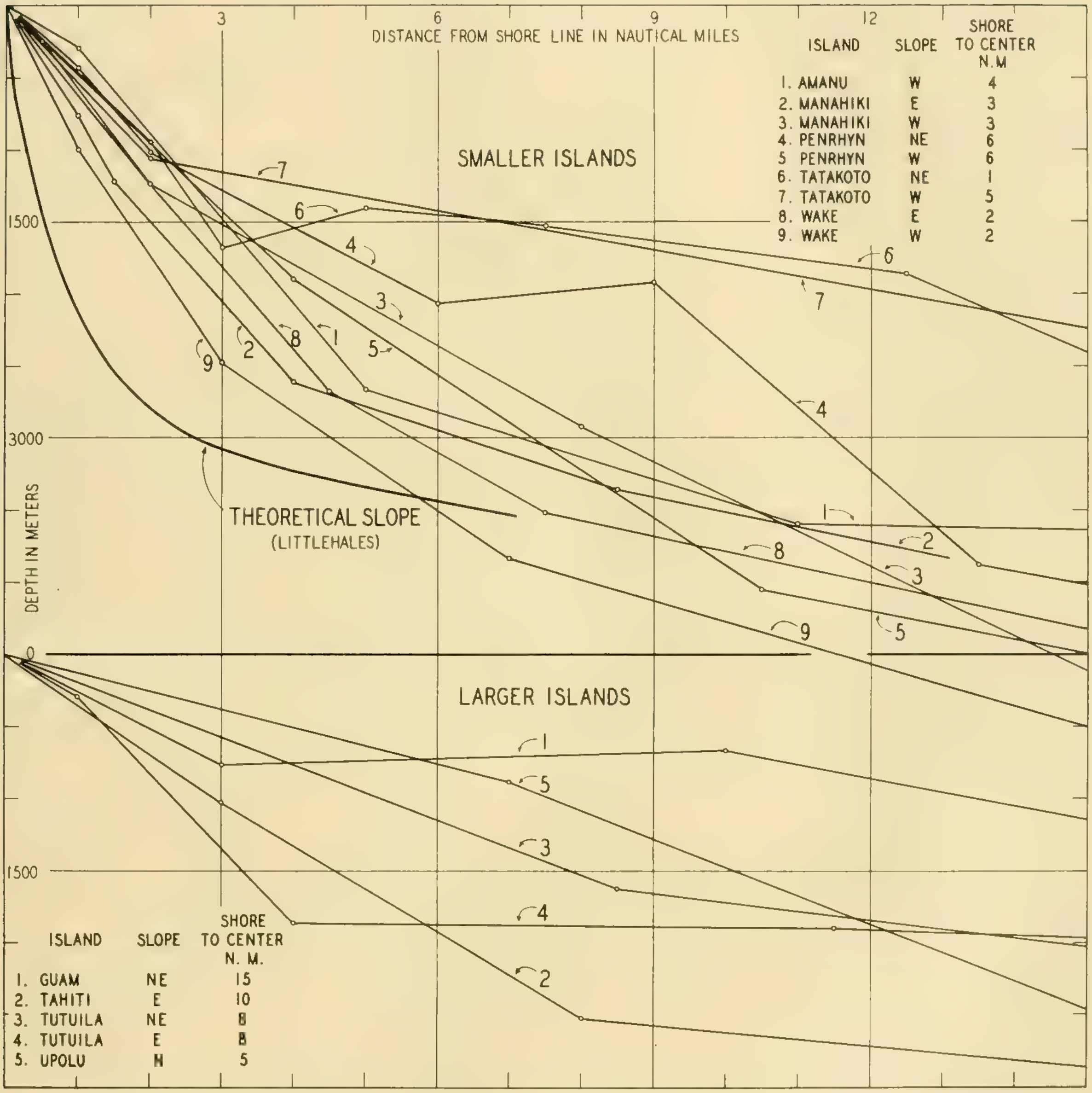


FIG. 1—SLOPES OF ISLANDS AS DEVELOPED FROM SONIC-DEPTH RESULTS ON CRUISE VII OF THE CARNEGIE, PACIFIC OCEAN, OCTOBER, 1928, TO NOVEMBER, 1929

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DEPARTMENT OF TERRESTRIAL MAGNETISM
J. A. Fleming, Director

Scientific Results of Cruise VII of the CARNEGIE during 1928-1929
under Command of Captain J. P. Ault

OCEANOGRAPHY — I-B

Observations and Results in Physical Oceanography

GRAPHICAL AND TABULAR SUMMARIES

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GRAPHICAL AND TABULAR SUMMARIES

GENERAL REMARKS

Oceanography I-B.--The present volume assembles together the graphs, figures, and tables of the oceanographic data gathered on, and the abstract of log for, cruise VII of the Carnegie. These data are collected here in one volume in order that they may be available for ready cross-reference in studies of the texts of any other volume of the series.

The locations of the oceanographic stations, the sounding velocity sections, and the selected vertical regions are shown by the three maps, figures 1 to 3.

The results of the sonic depth work are presented by ten graphs, figures 4 to 13, illustrating the bottom profiles. These graphs were constructed by using the exact distances between the stations. The plotted depths to the bottom then were joined by straight lines. No attempt was made to smooth these graphs because of the usually wide separation of the stations and the probably irregular topography between them.

The physical and chemical data for each station are given graphically in figures 14 to 92. The observed values are shown by smooth curves. These graphs represent reduced reproductions of similar larger graphs from which were scaled the depths of standard values and values of the observed elements. By plotting together all observed elements at one station, a representation of the simultaneous values is obtained which serves to illustrate the interrelations between the various elements.

Figures 93 to 200 give the vertical distribution of sounding velocity, temperature, salinity, density, pH, and PO_4 for the sixteen selected sections shown in the map, figure 3. At sections 5, 7, 14, and 15 the vertical distribution of SiO_2, O_2 ml/L, and O_2 in saturation per cent are given also. The actual distances between the stations were used in constructing these sections. From curves showing the vertical distribution of the various elements at each single station, the depths of standard values were scaled and plotted in the section and joined by smooth curves. When constructing these curves, due attention was paid to the occurrence of maxima and minima.

Figures 201 to 209 illustrate the temperature-salinity relation at individual stations in the Atlantic and the Pacific oceans.

Figures 210 to 245 present the horizontal distribution of temperature, salinity, and density at standard levels. When these charts were constructed, values of the elements at standard levels were read from the smooth curves representing the observed conditions at each individual station. These values are entered on charts and, by interpolation, curves were drawn. In these graphs for the lower levels, for which few data were obtained, the course of the curves at higher levels was taken into account.

Figures 246 to 254 show the topography of standard isobaric surfaces relative to the topography of the 2000-decibar surface. The charts were constructed on the basis of the computed values given in the tables of results.

A continuous record of surface sea-water temperature at a depth of approximately 2 meters below the surface was maintained by means of a sea-water thermograph with 24-hour movement. The data scaled from these records are given in table 1. Control of the thermograms was effected by noting the temperature of the surface water by the bucket method immediately before each change of the record at noon. When the surface temperatures were changing rapidly, a mean of several bucket readings was used for the control.

Table 2 gives the physical and chemical data and results of dynamic computations for the 162 Carnegie deep-sea stations. The observed, interpolated, and computed values are presented.

A synoptic description of the bottom samples collected in the Pacific is given in table 3. The samples are numbered consecutively from 10 to 89 in the first column of the table. Succeeding columns give information as follows: Stations at which the samples were collected; latitude and longitude; corrected depths; classification of the samples and the estimated calcium carbonate contents, together with the bases of the estimates; colors of the samples; brief descriptions of the physical characters; samplers and containers used in the collection and preservation of the samples, extracts from the field notes made on shipboard at the time the samples were collected; and descriptions of the nearest previous samples collected by other ships in the Pacific. The tabular footnotes describe briefly the organic and inorganic components and any characteristic or remarkable features of the samples which were analyzed mechanically. Except when otherwise indicated, these descriptions are based only on microscopic examination of the sand grades (particles larger than 0.05 mm in diameter). For samples which were too small for mechanical analysis, a rough petrographic examination of a part of the undifferentiated material was made.

Table 4 gives the number and geographic position of a total of 1496 soundings made in the Atlantic and Pacific oceans between May 13, 1928, and November 18, 1929.

The sounding velocities computed from the conditions found to exist at the oceanographic stations are given in table 5. In this table the values appearing below the heavy line are based on extrapolated temperatures or salinities. The values given probably are significant to a few tenths of a meter per second as representing the conditions at the time measurements were made, but must not be relied on as representing the conditions at any other time.

The volume is concluded with the abstract of log from May 1, 1928, the date of departure from Washington, D. C., through November 18, 1929, when the vessel arrived at Pago Pago, Samoa. The log from Pago Pago to Apia was lost in the destruction of the Carnegie at Samoa on November 29, 1929.

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FIGURES AND GRAPHS 1 TO 254

After completion of the computations for the results of this table, it was found that the values of salinity of the deep water between 34.6 and 35.0 are about 0.03 per mille too low. This correction should be borne in mind in utilizing the tabular values (see Oceanography 1-A)

FIG. 1—OCEANOGRAPHIC STATIONS, CRUISE VII OF THE CARNEGIE, 1928-1929

FIG. 2—VERTICAL SECTIONS SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928—1929

FIG. 3—REGIONS IN WHICH SOUNDING VELOCITY CORRECTION FACTORS ARE NEARLY THE SAME IN EACH REGION, PACIFIC OCEAN, CARNEGIE RESULTS, 1928-1929

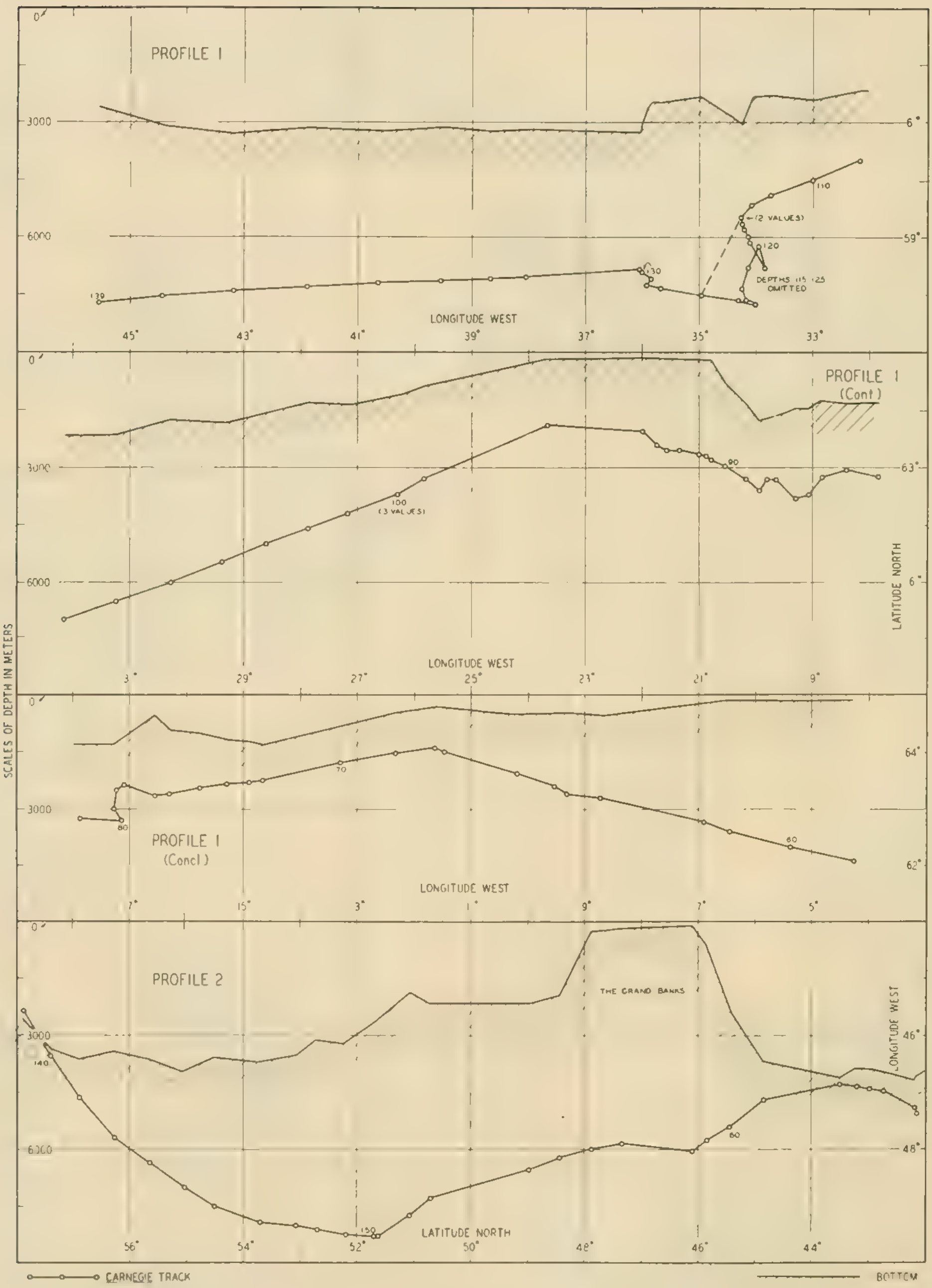


FIG 4—BOTTOM PROFILES 1-2, ATLANTIC OCEAN, CARNEGIE SONIC DEPTHS 59-167, JULY 12 TO AUGUST 9, 1928

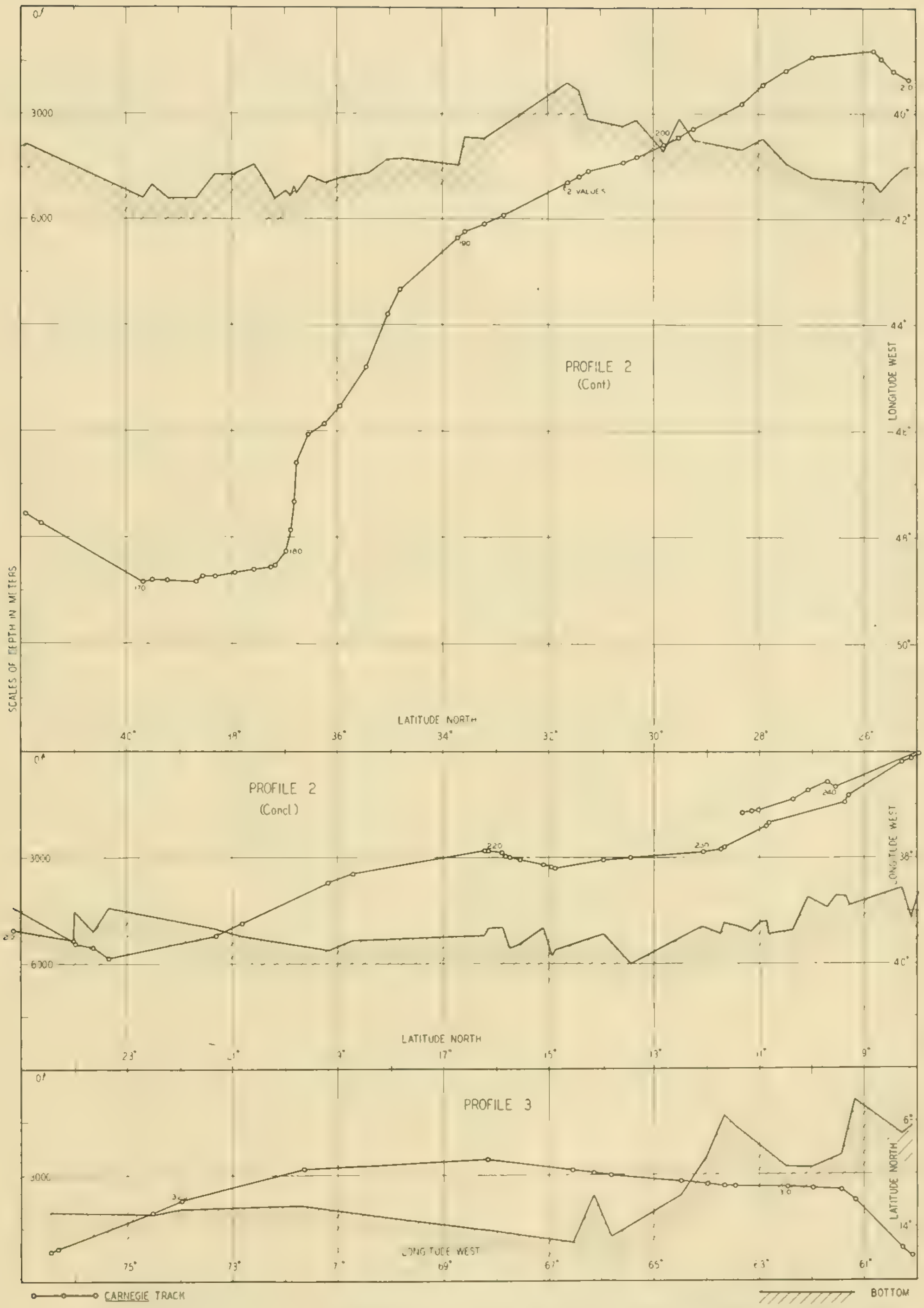


FIG. 5—BOTTOM PROFILES 2-3, ATLANTIC OCEAN, CARNEGIE SONIC DEPTHS 168-246, 305-322, AUGUST 9 TO SEPTEMBER 3, OCTOBER 1-8, 1928

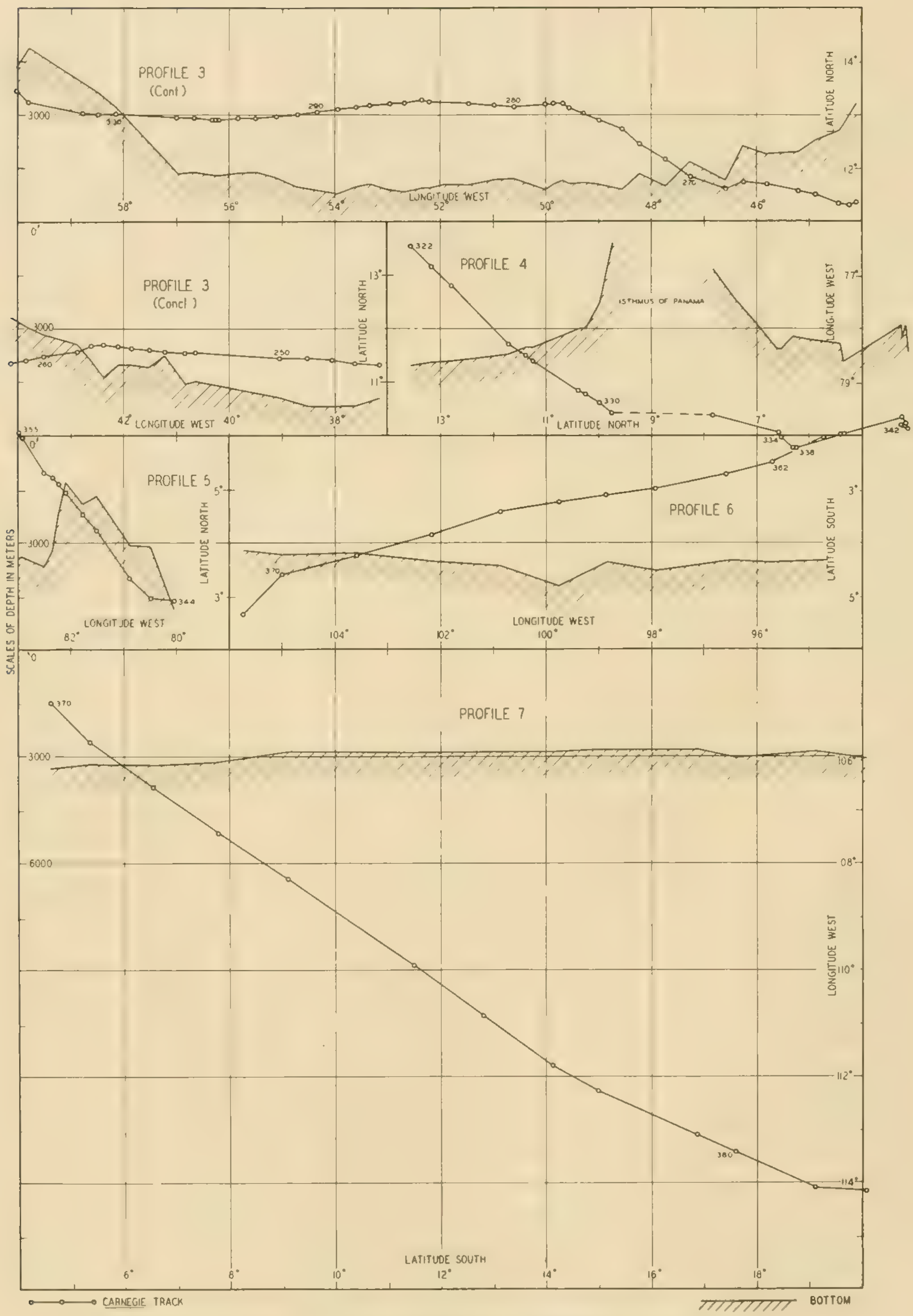


FIG 6 — BOTTOM PROFILES 3-7, ATLANTIC AND PACIFIC OCEANS, CARNEGIE SONIC DEPTHS 262-382, SEPTEMBER 7 TO NOVEMBER 25, 1928

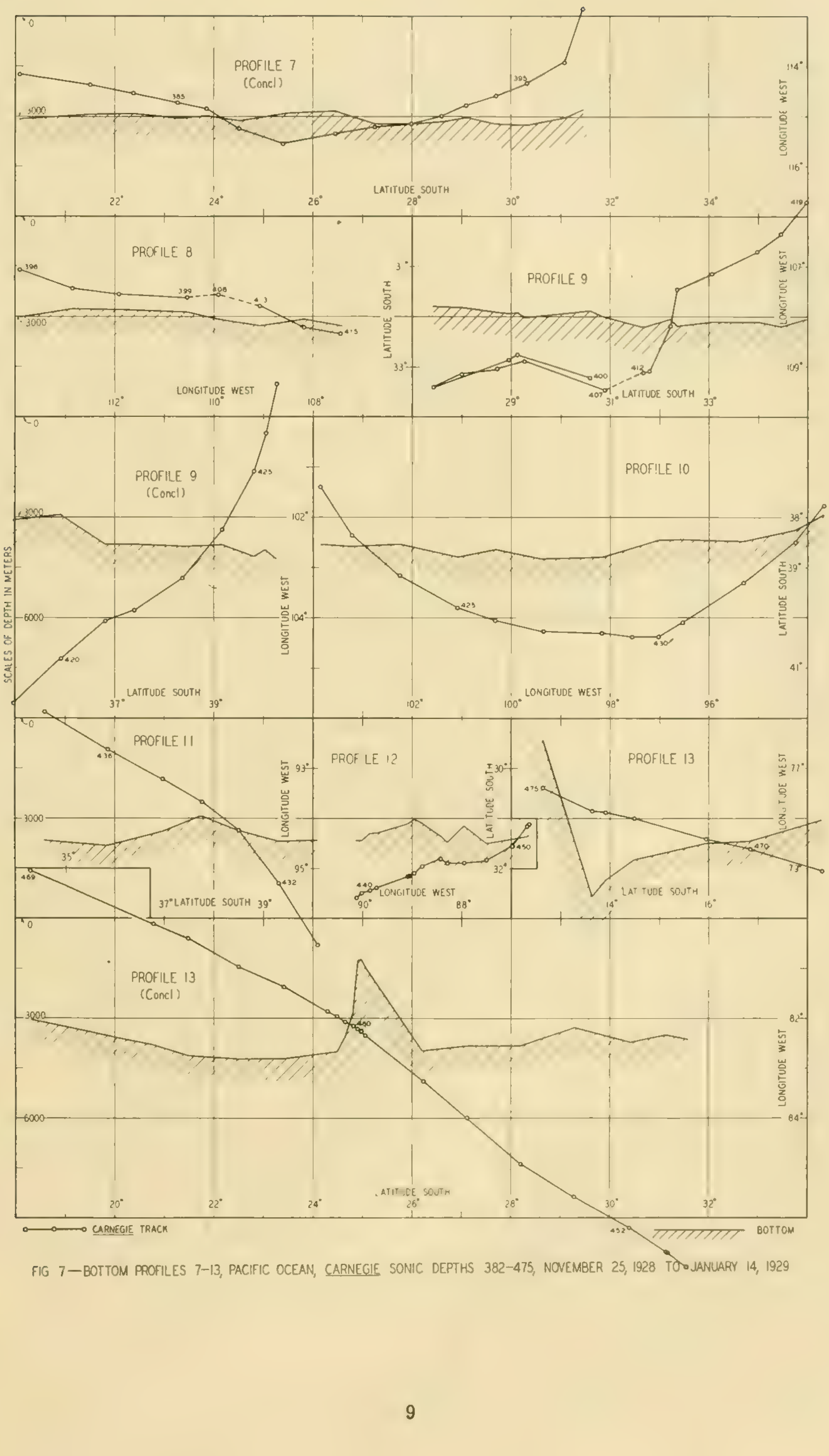


FIG 7—BOTTOM PROFILES 7–13, PACIFIC OCEAN, CARNEGIE SONIC DEPTHS 382–475, NOVEMBER 25, 1928 TO JANUARY 14, 1929

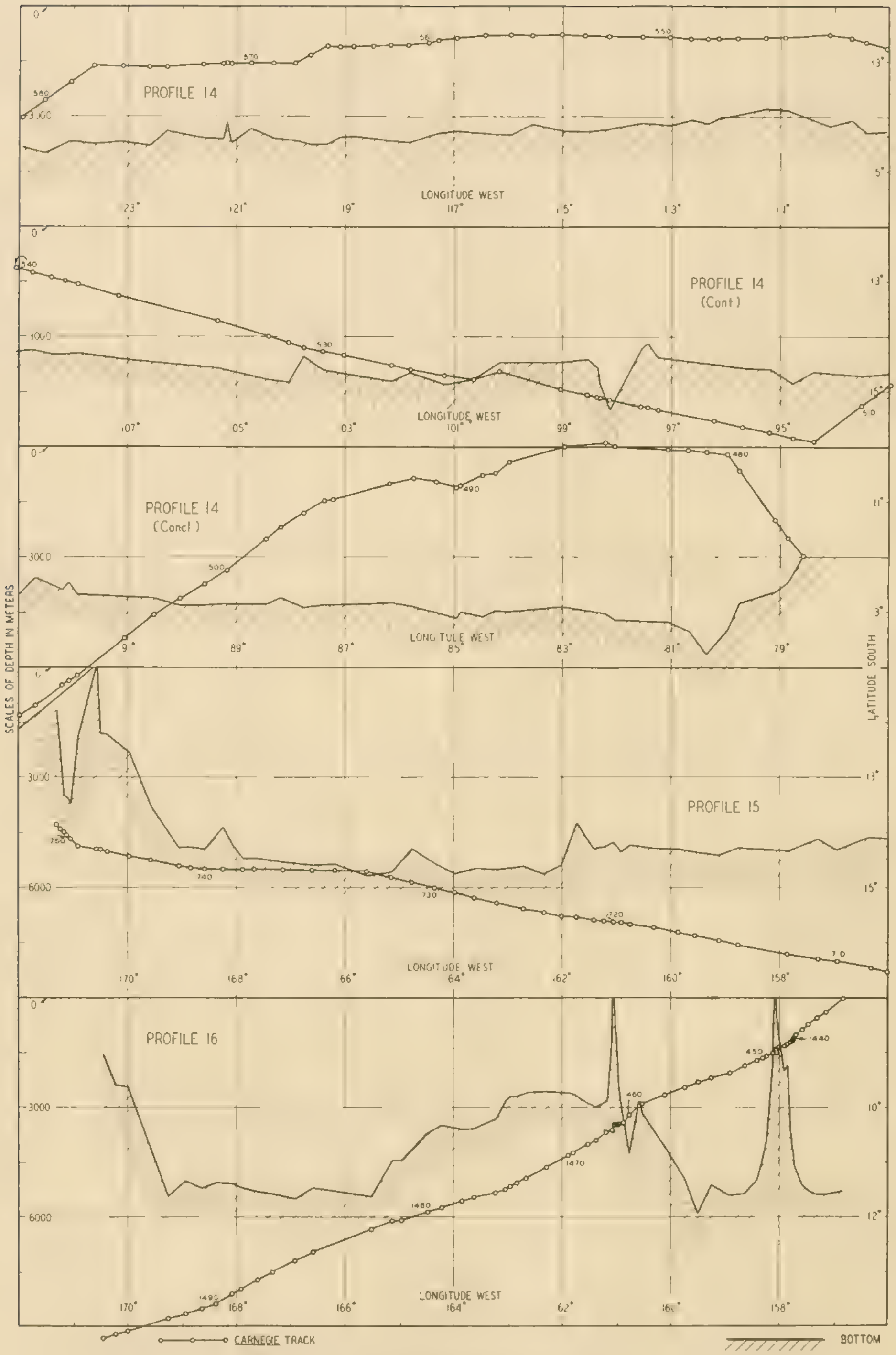


FIG. 8—BOTTOM PROFILES 14–16, PACIFIC OCEAN, CARNEGIE SONIC DEPTHS 476–581, 708–753, 1433–1496, FEBRUARY 6–27, MARCH 25 TO APRIL 6, NOVEMBER 9–18, 1929

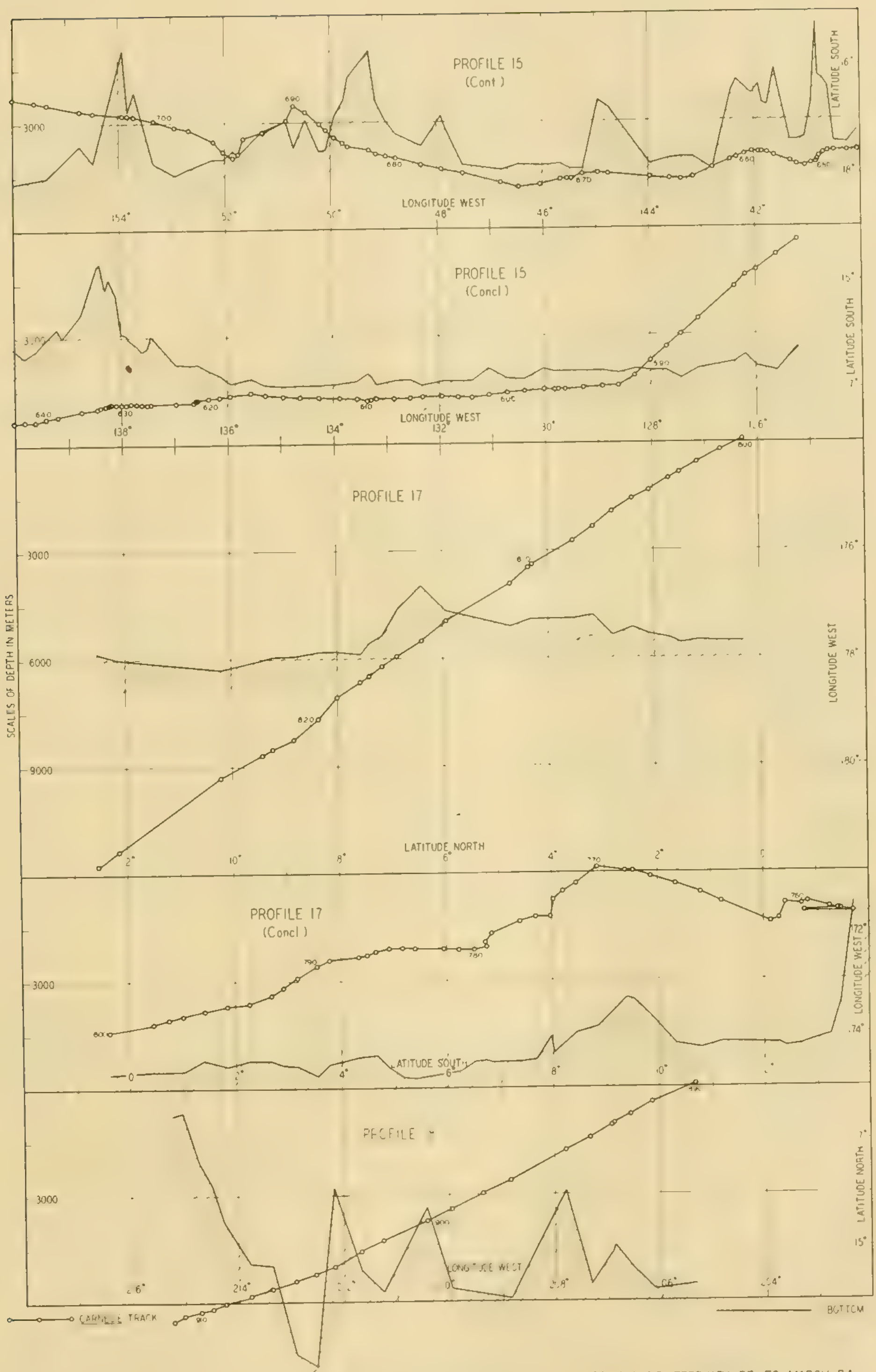


FIG 9—BOTTOM PROFILES 15-18, PACIFIC OCEAN, *CARNEGIE* SONIC DEPTHS 582-708, 754-826, 890-912, FEBRUARY 27 TO MARCH 24, APRIL 20 TO MAY 7, MAY 14-20, 1929

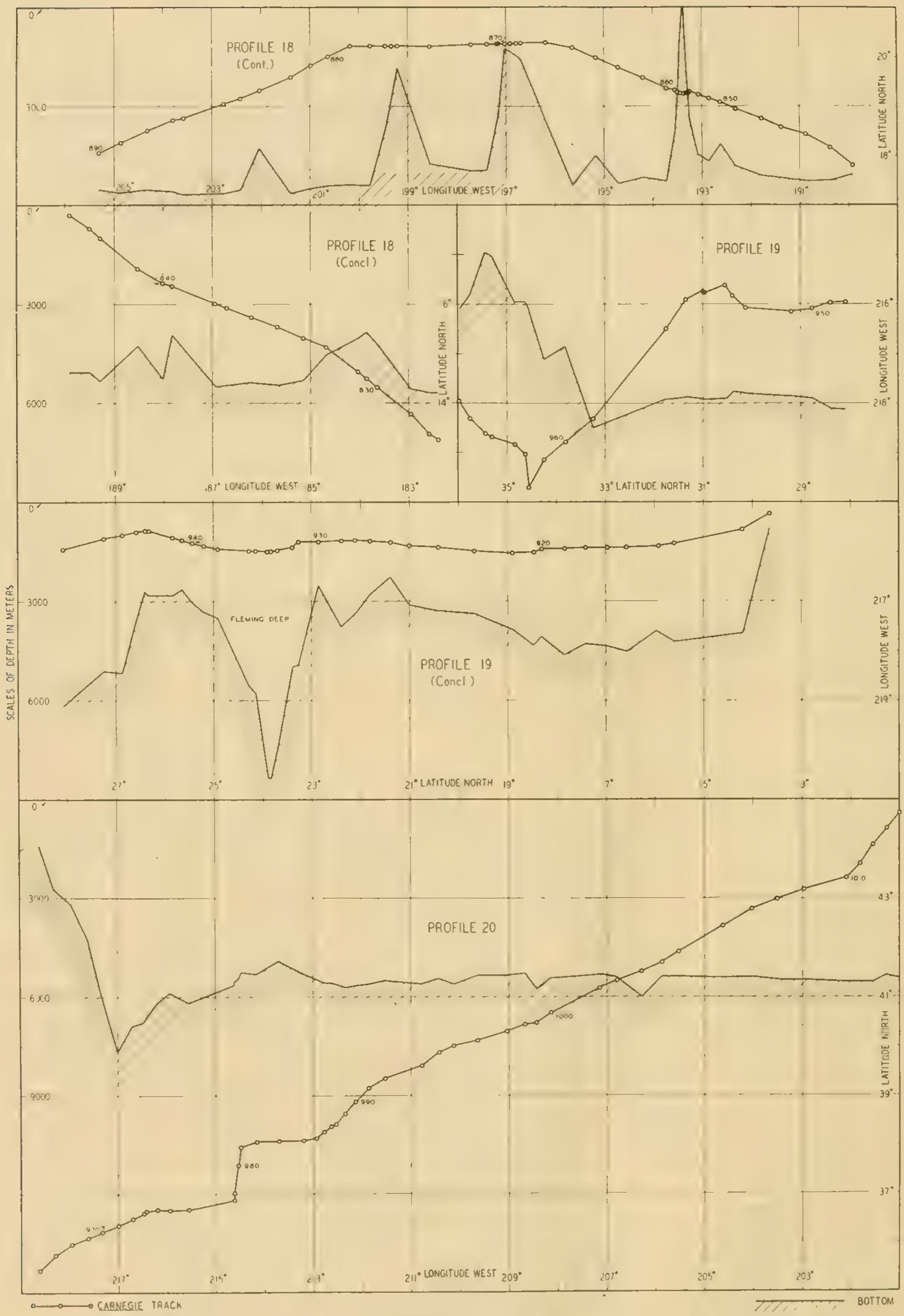


FIG 10—BOTTOM PROFILES 18–20, PACIFIC OCEAN, CARNEGIE SONIC DEPTHS 827–890, 912–1014, MAY 7–15, MAY 20 TO JULY 7, 1929

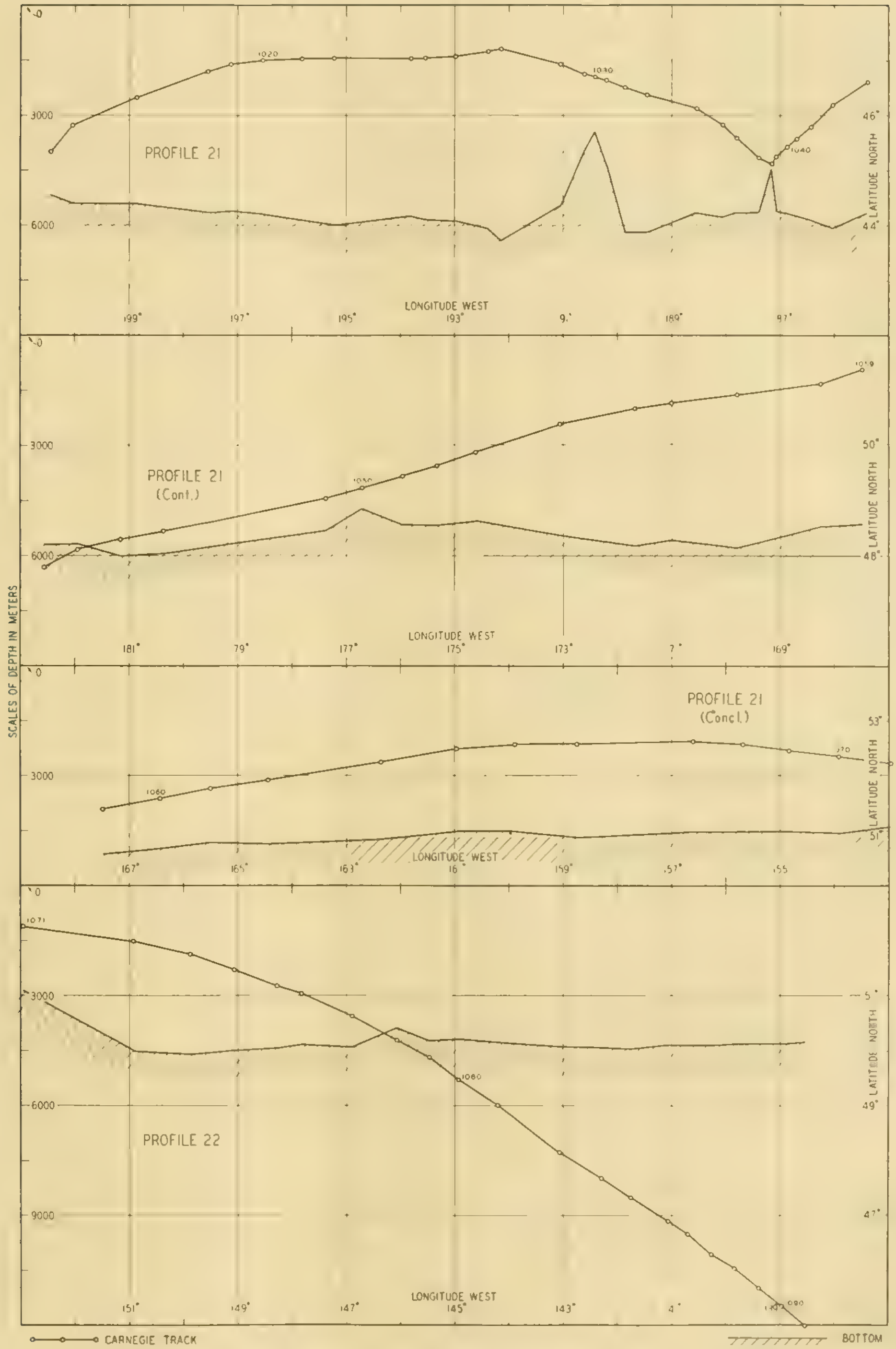


FIG 11—BOTTOM PROFILES 21-22, PACIFIC OCEAN, CARNEGIE SONIC DEPTHS 1015–1091, JULY 7–22, 1929

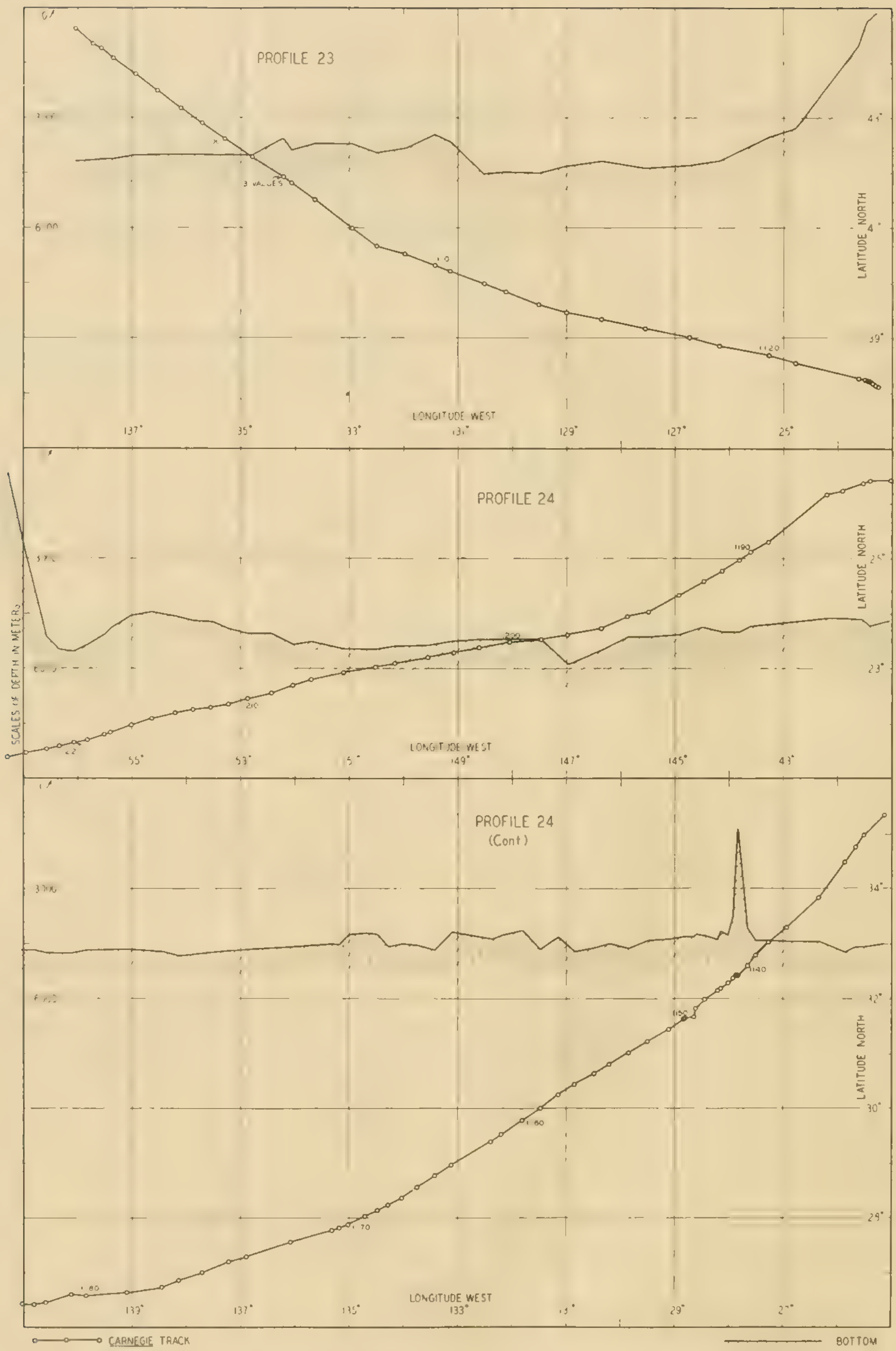


FIG 12—BOTTOM PROFILES 23–24, PACIFIC OCEAN, CARNEGIE SONIC DEPTHS 1092–1128, 1132–1224, JULY 23–28, SEPTEMBER 5–23, 1929

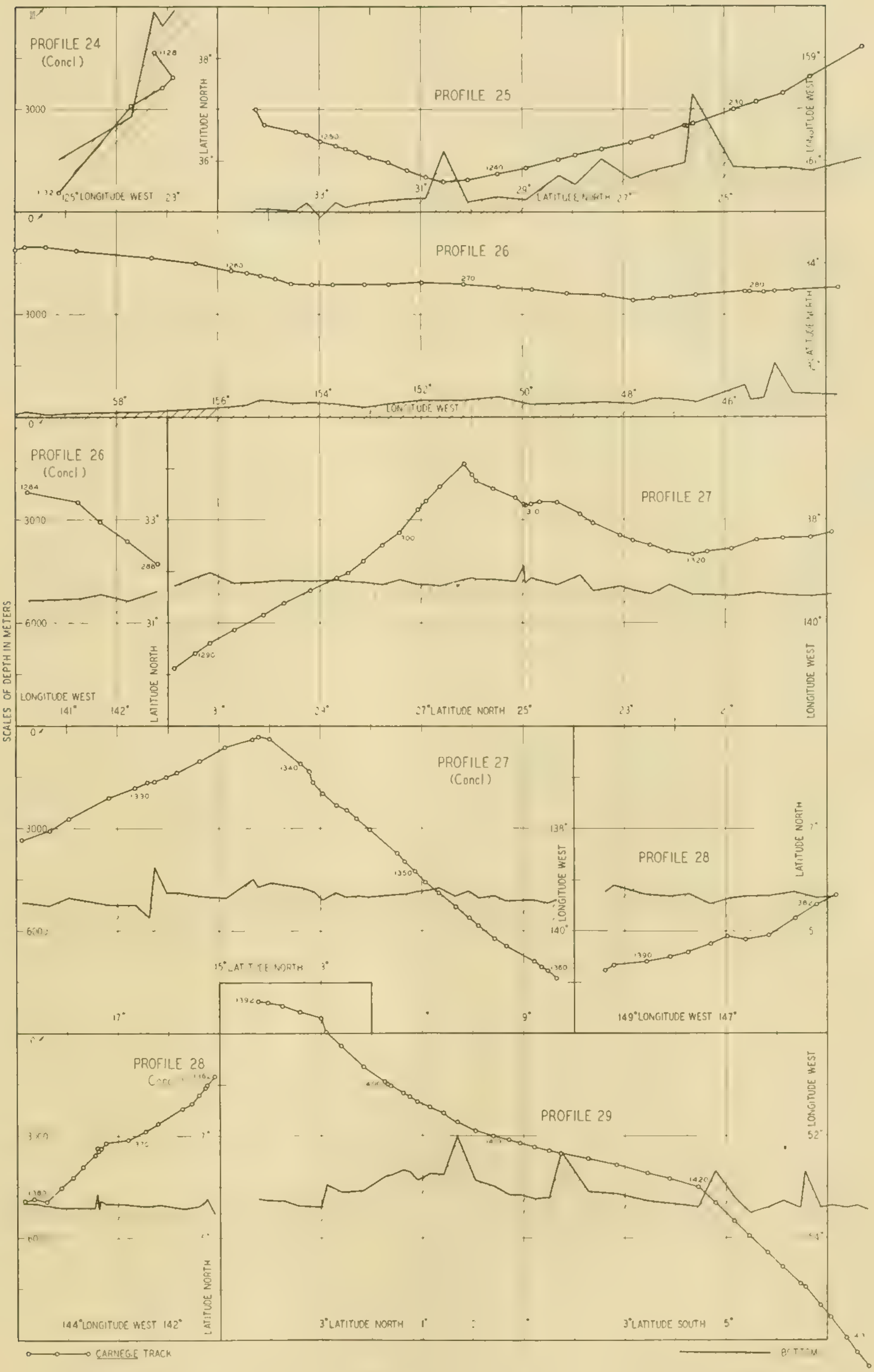


FIG 13–BOTTOM PROFILES 24–29, PACIFIC OCEAN, CARNEGIE SONIC DEPTHS 1128–1132, 1226–1432, JULY 28 TO SEPTEMBER 5, OCTOBER 2 TO NOVEMBER 9, 1929

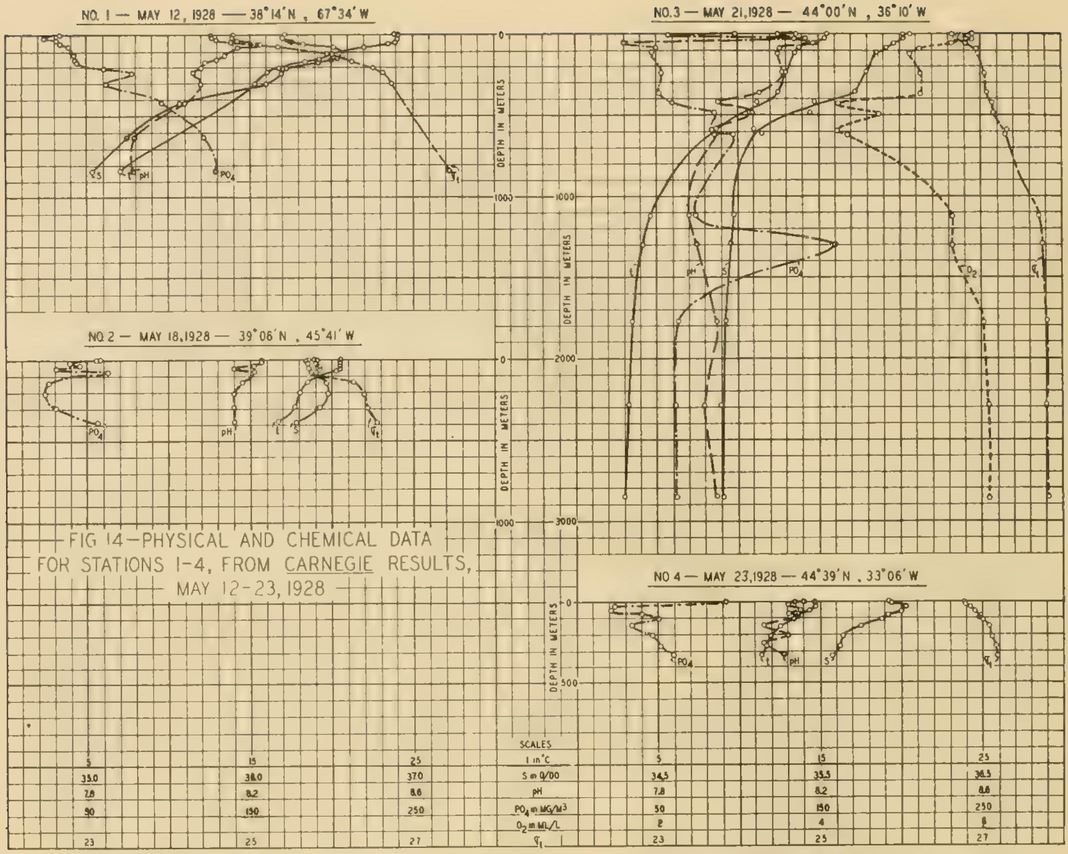


FIG 14—PHYSICAL AND CHEMICAL DATA FOR STATIONS 1-4, FROM CARNEGIE RESULTS, MAY 12-23, 1928

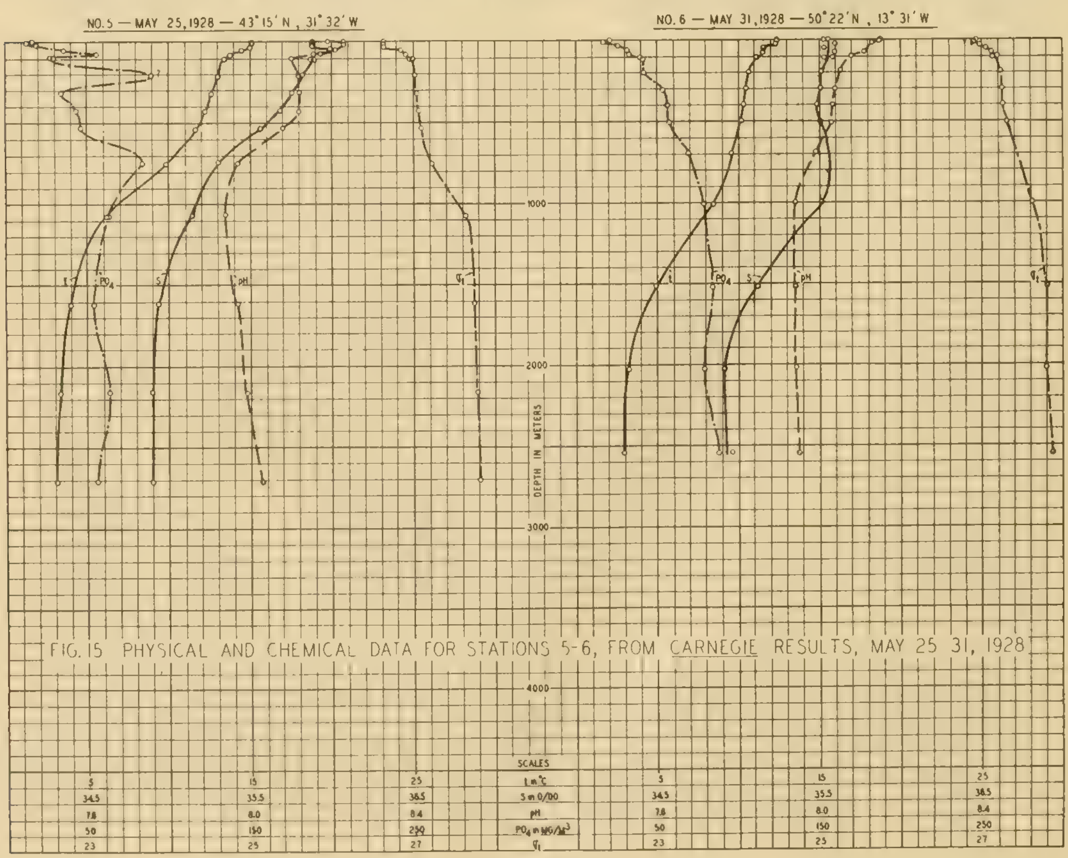


FIG. 15 PHYSICAL AND CHEMICAL DATA FOR STATIONS 5-6, FROM CARNEGIE RESULTS, MAY 25 31, 1928

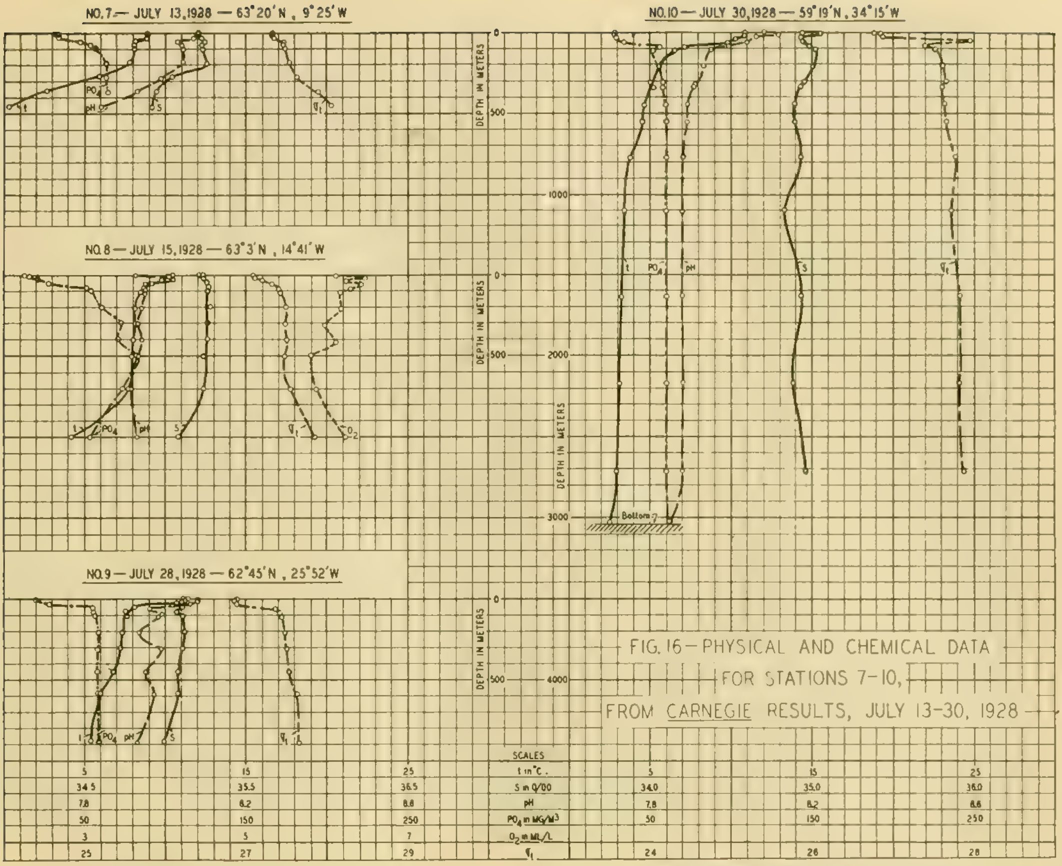


FIG. 16 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 7-10, FROM *CARNEGIE* RESULTS, JULY 13-30, 1928

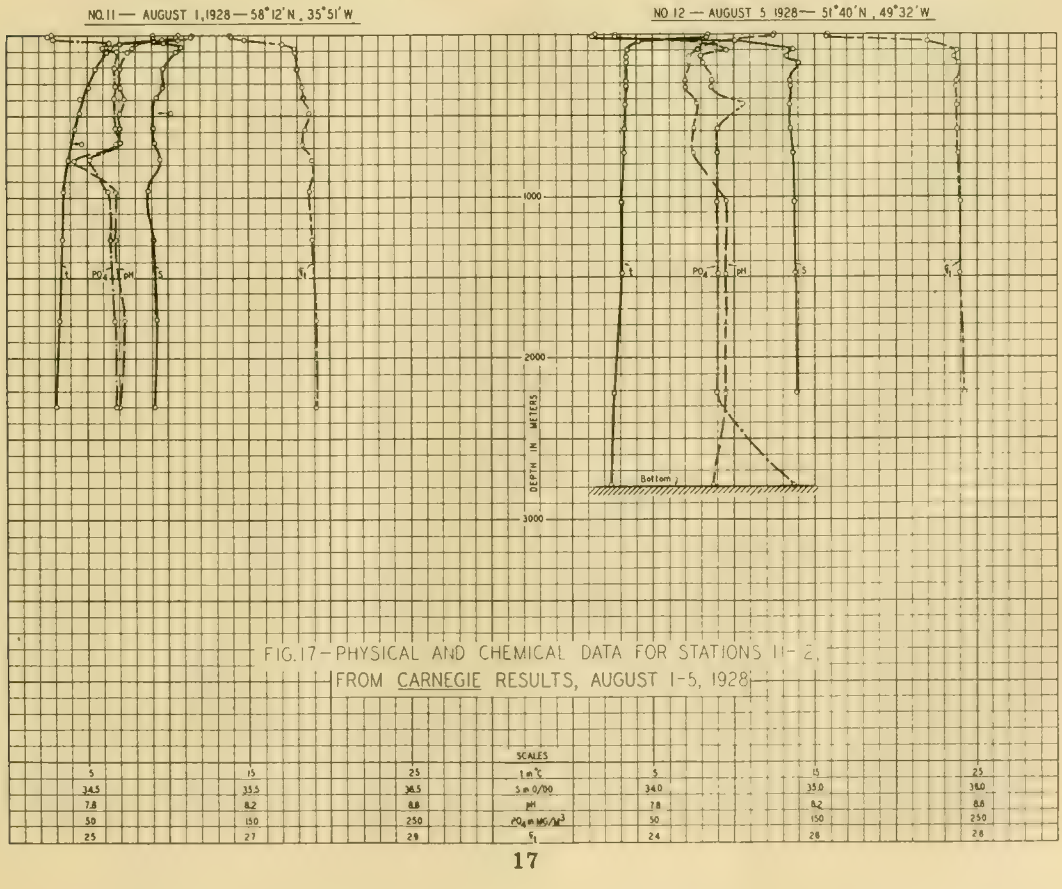


FIG. 17 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 11-12, FROM *CARNEGIE* RESULTS, AUGUST 1-5, 1928

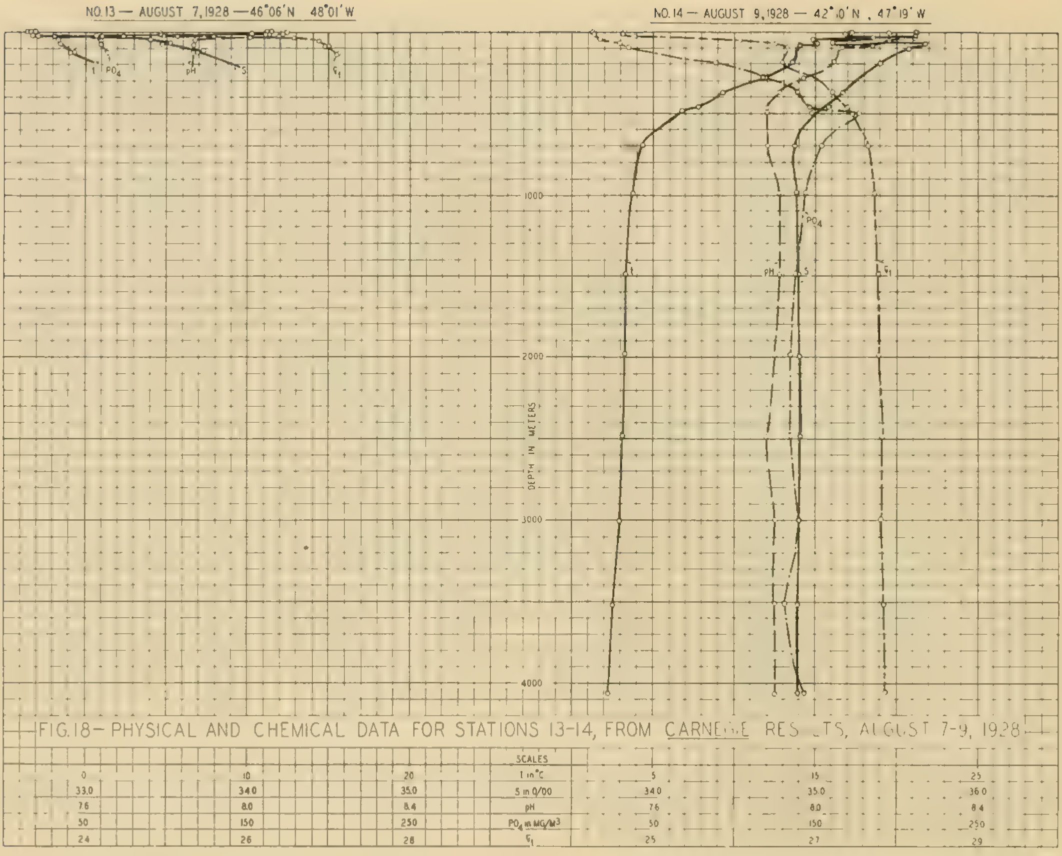


FIG. 18 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 13-14, FROM CARNEGIE RESULTS, AUGUST 7-9, 1928

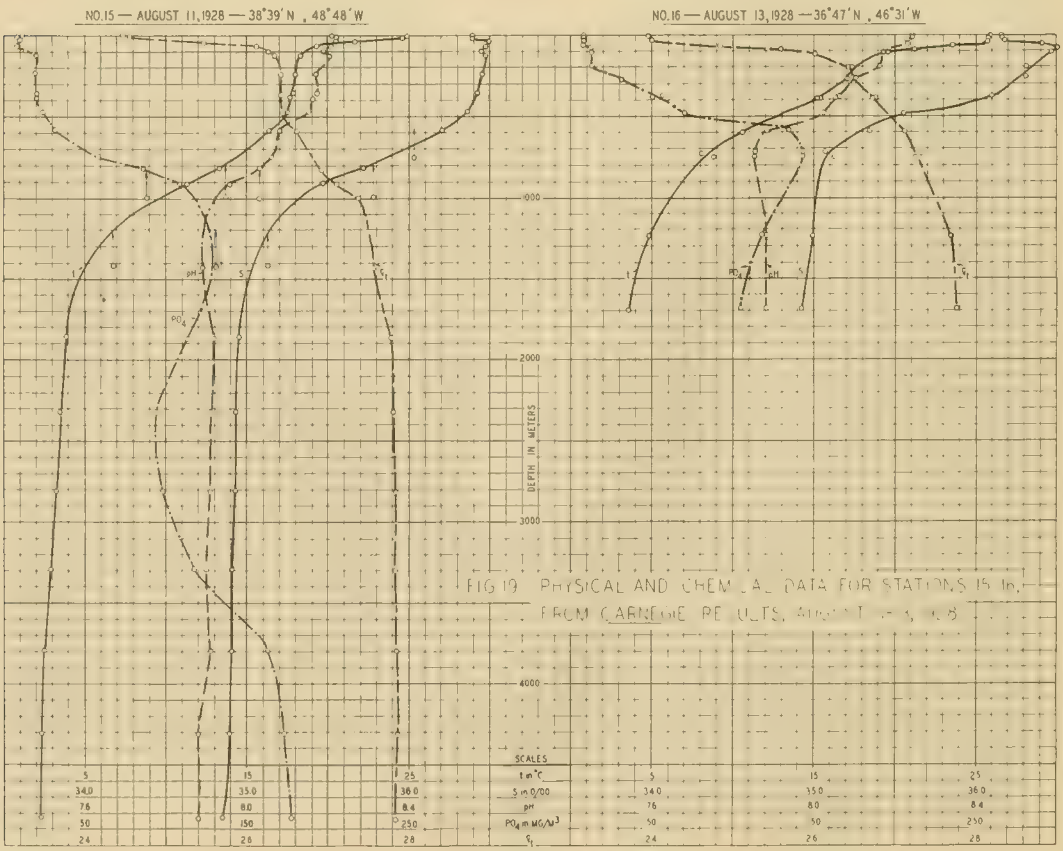


FIG. 19 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 15-16, FROM CARNEGIE RESULTS, AUGUST 11-13, 1928

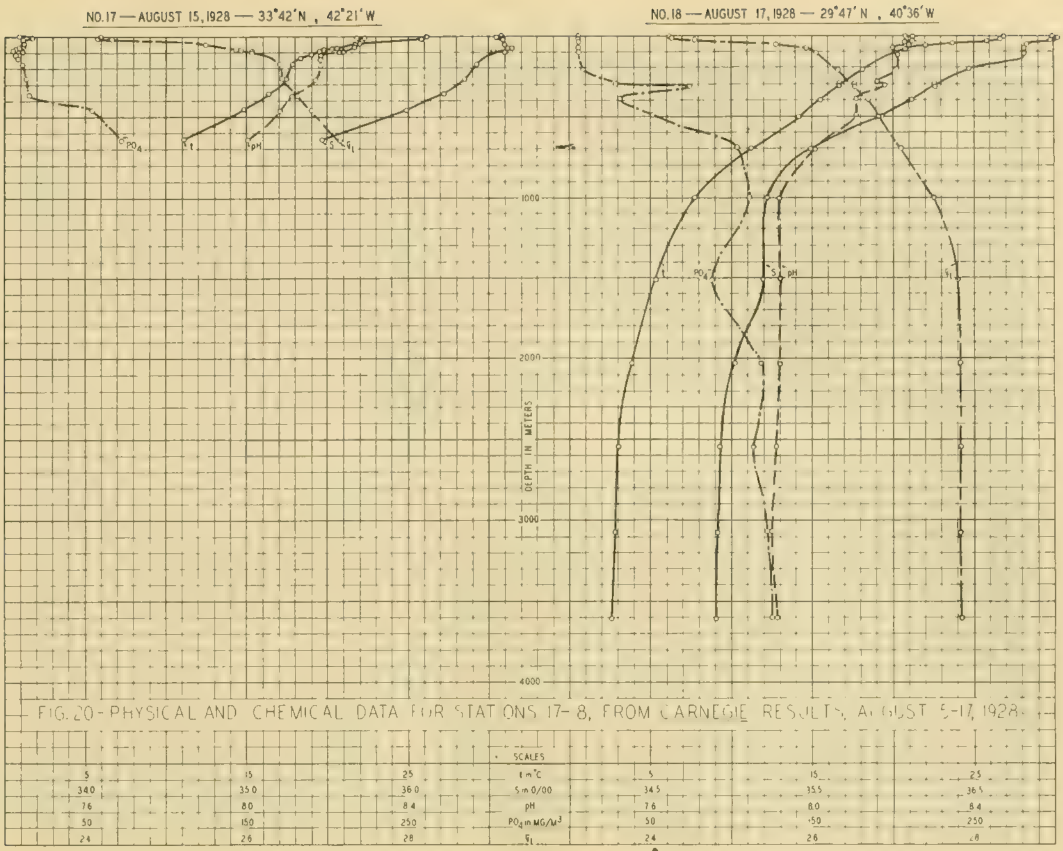


FIG. 20 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 17-18, FROM CARNEGIE RESULTS, AUGUST 15-17, 1928.

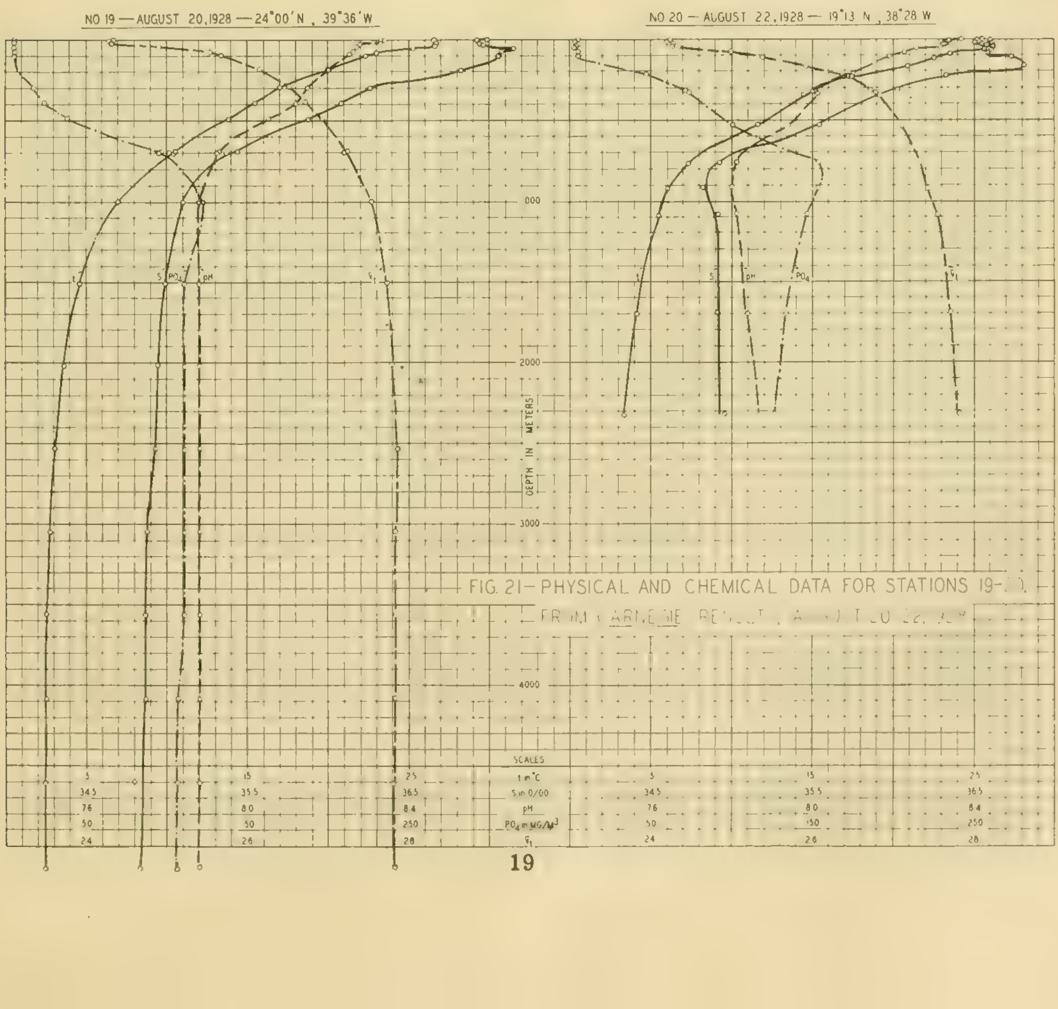


FIG. 21 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 19-20, FROM CARNEGIE RESULTS, AUGUST 20-22, 1928

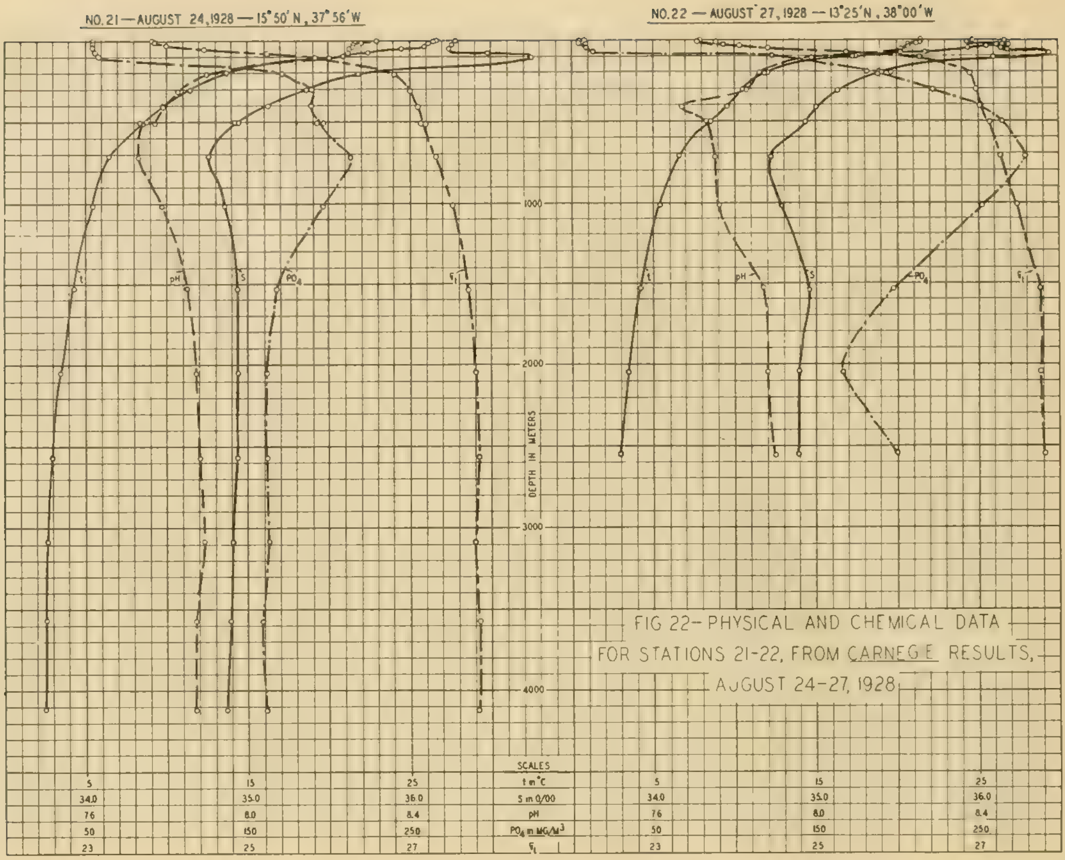


FIG. 22—PHYSICAL AND CHEMICAL DATA FOR STATIONS 21-22, FROM *CARNEGIE* RESULTS, AUGUST 24-27, 1928

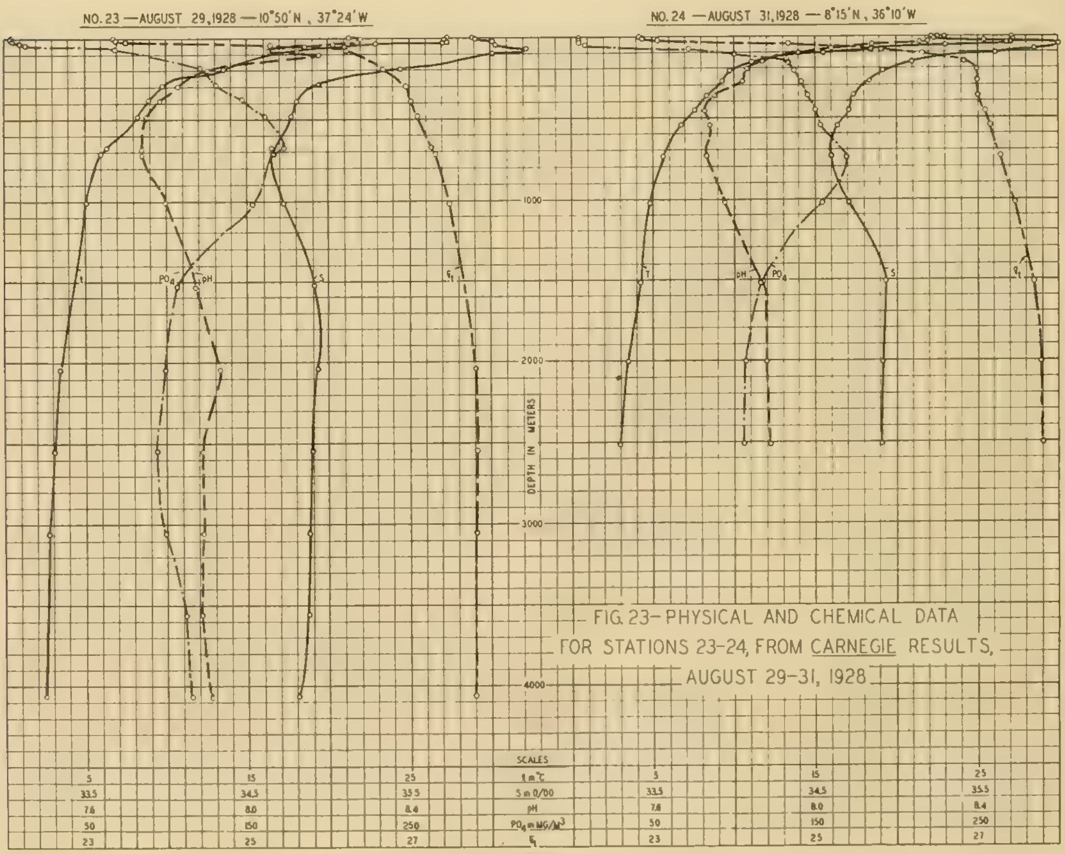


FIG. 23—PHYSICAL AND CHEMICAL DATA FOR STATIONS 23-24, FROM *CARNEGIE* RESULTS, AUGUST 29-31, 1928

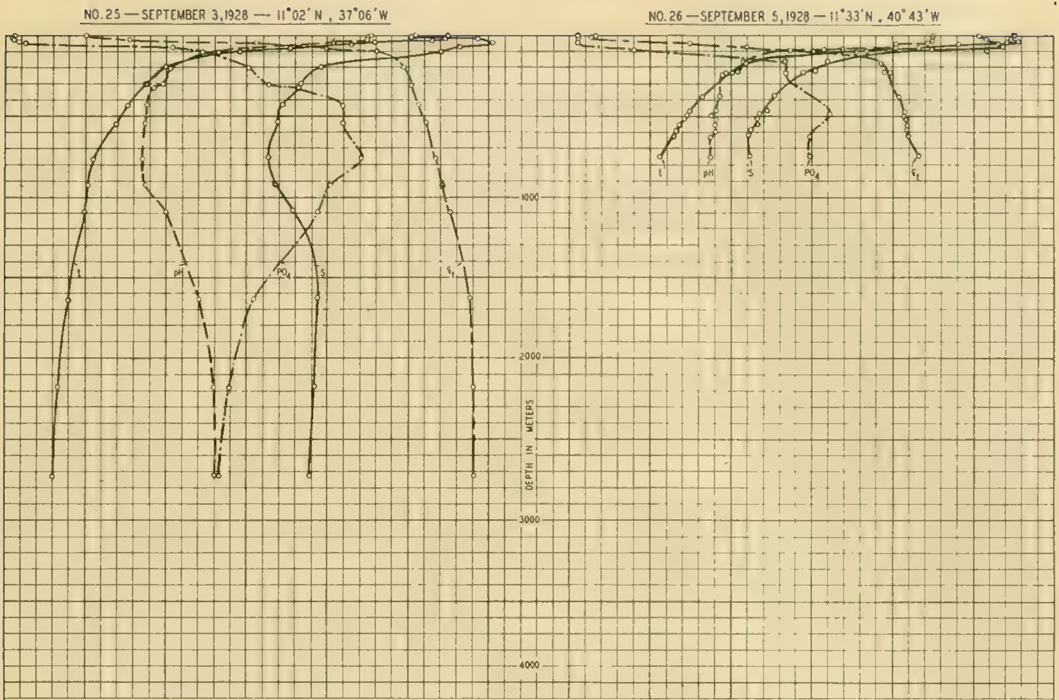


FIG. 24— PHYSICAL AND CHEMICAL DATA FOR STATIONS 25-26, FROM *CARNEGIE* RESULTS, SEPTEMBER 3-5, 1928

			SCALES			
5	15	25	t in °C	5	15	25
33.5	34.5	35.5	S in 0/00	34.0	35.0	36.0
7.6	8.0	8.4	pH	7.6	8.0	8.4
50	150	250	PO_4 in MG/M^3	50	150	250
23	25	27	σ_t	24	26	28

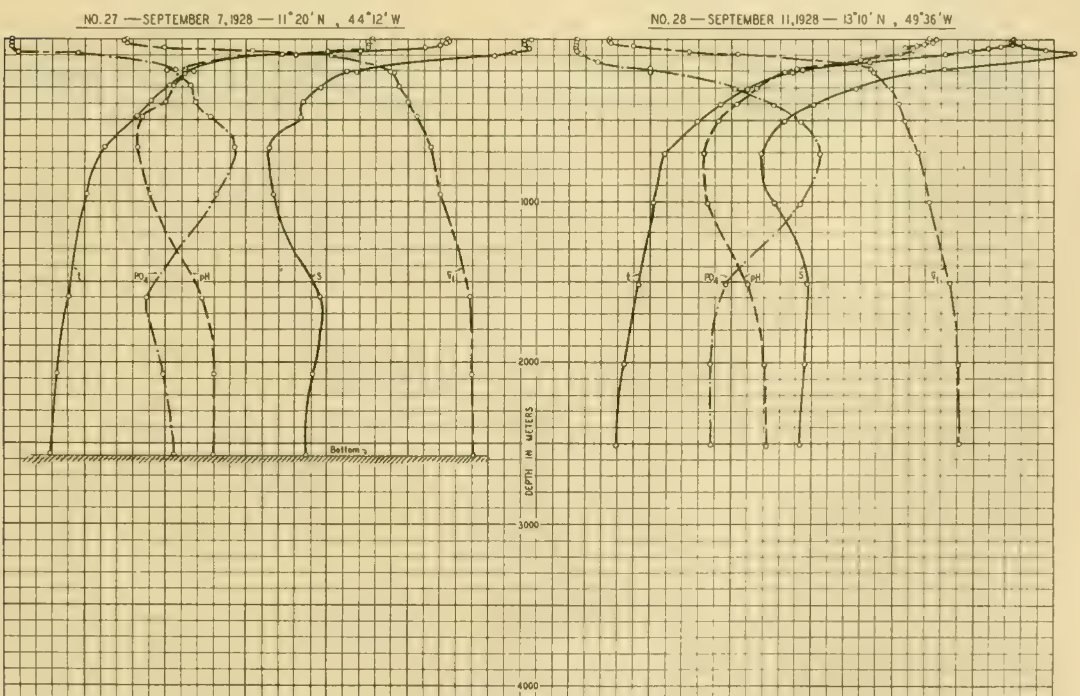


FIG. 25— PHYSICAL AND CHEMICAL DATA FOR STATIONS 27-28, FROM *CARNEGIE* RESULTS, SEPTEMBER 7-11, 1928

			SCALES			
5	15	25	t in °C	5	15	25
33.5	34.5	35.5	S in 0/00	34.0	35.0	36.0
7.8	8.0	8.4	pH	7.6	8.0	8.4
50	150	250	PO_4 in MG/M^3	50	150	250
23	25	27	σ_t	24	28	28

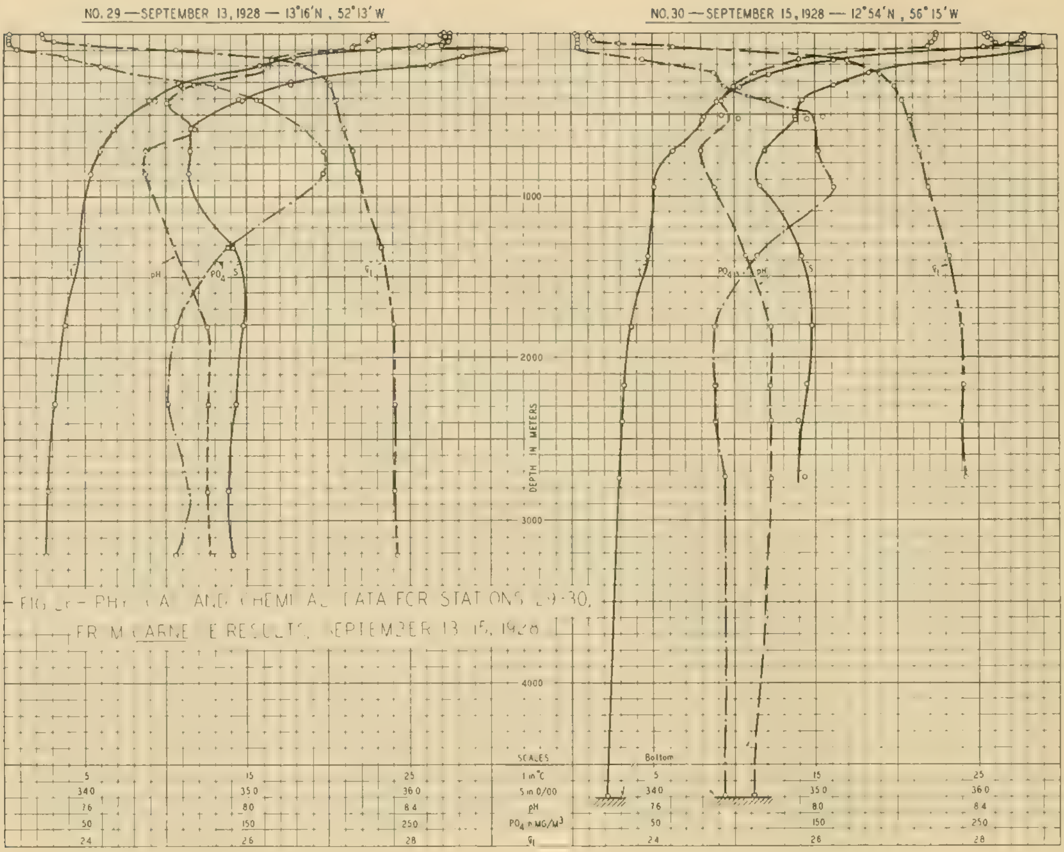


FIG. 26 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 29-30, FROM CARNEGIE RESULTS, SEPTEMBER 13-15, 1928

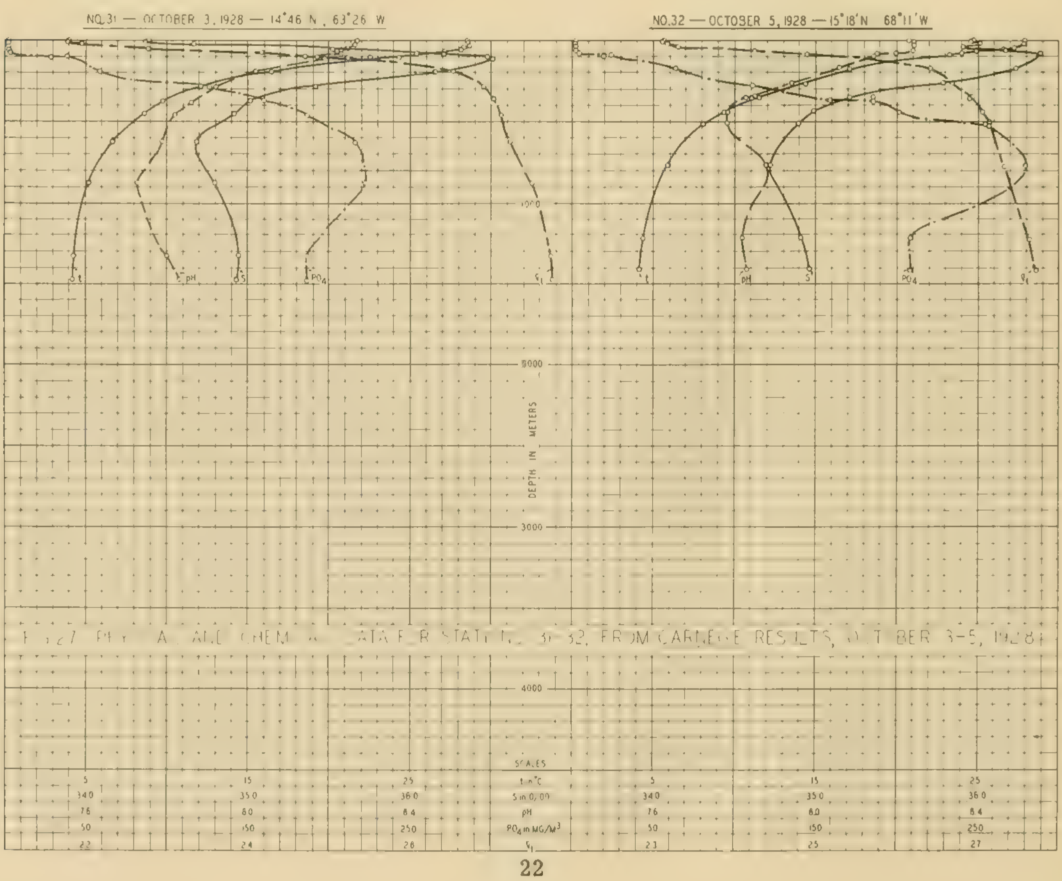


FIG. 27 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 31-32, FROM CARNEGIE RESULTS, OCTOBER 3-5, 1928

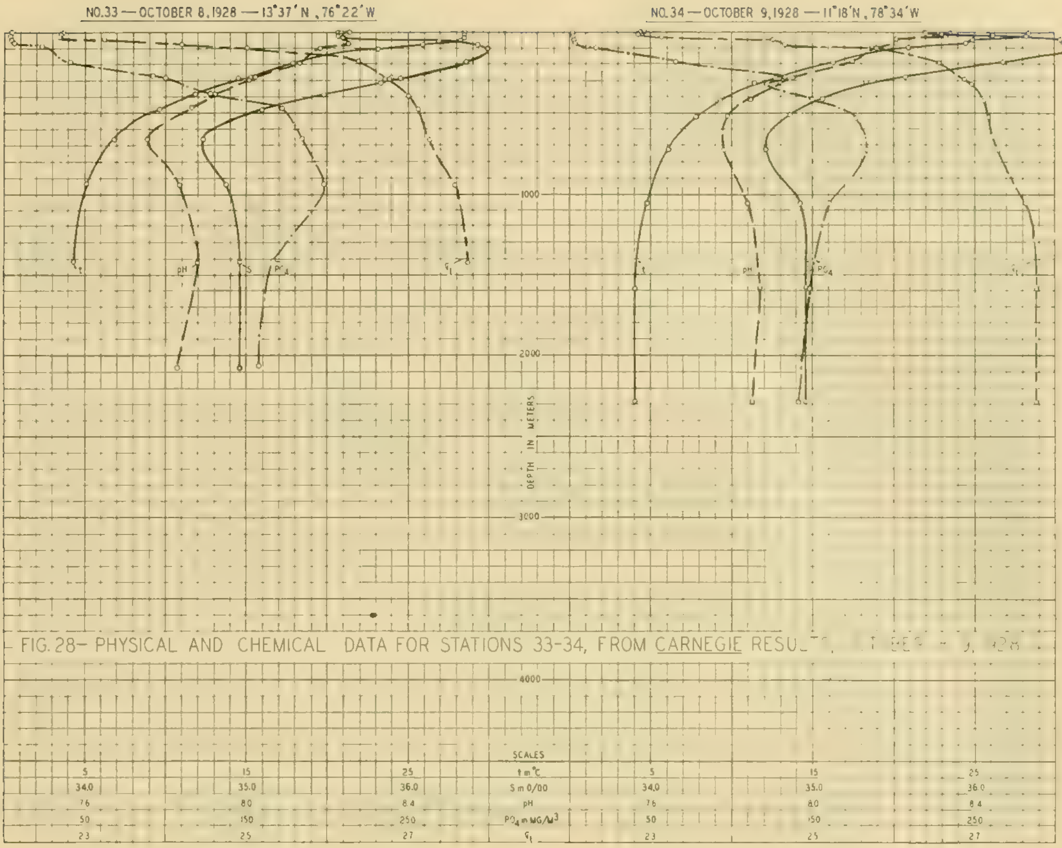


FIG. 28– PHYSICAL AND CHEMICAL DATA FOR STATIONS 33-34, FROM CARNEGIE RESULTS, OCTOBER 8-9, 1928

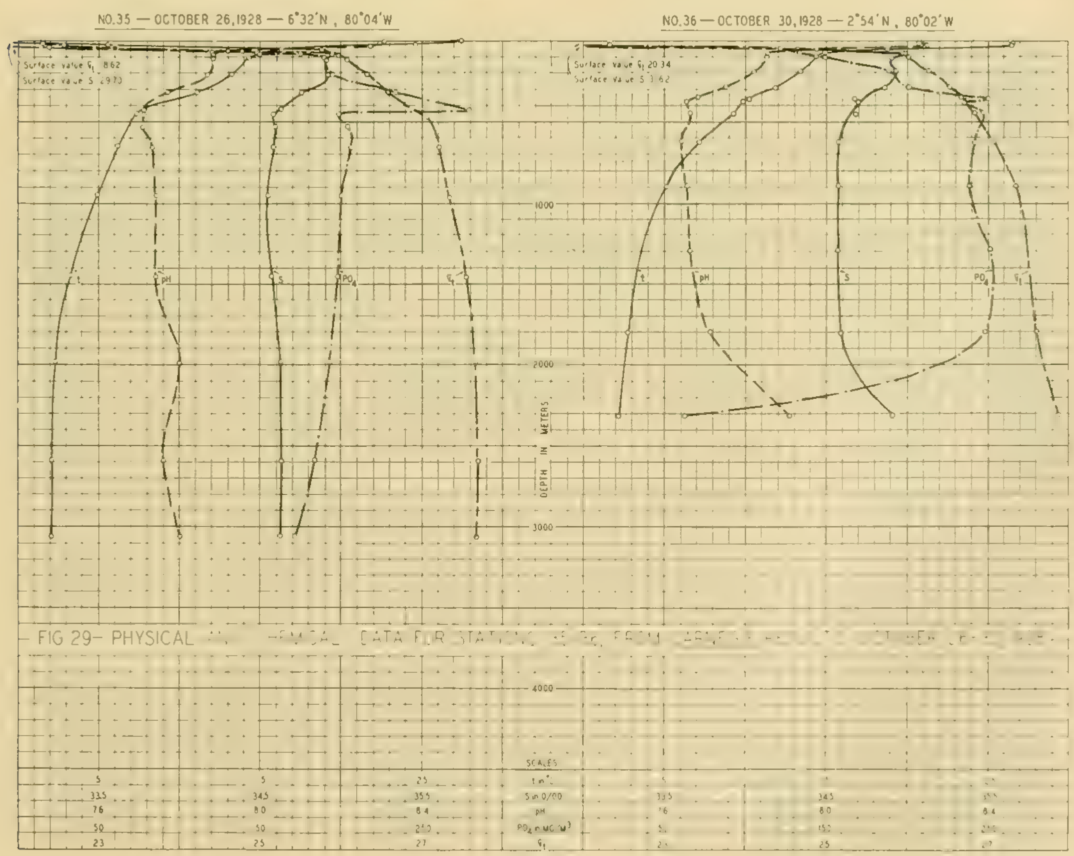


FIG 29– PHYSICAL AND CHEMICAL DATA FOR STATIONS 35-36, FROM CARNEGIE RESULTS, OCTOBER 26-30, 1928

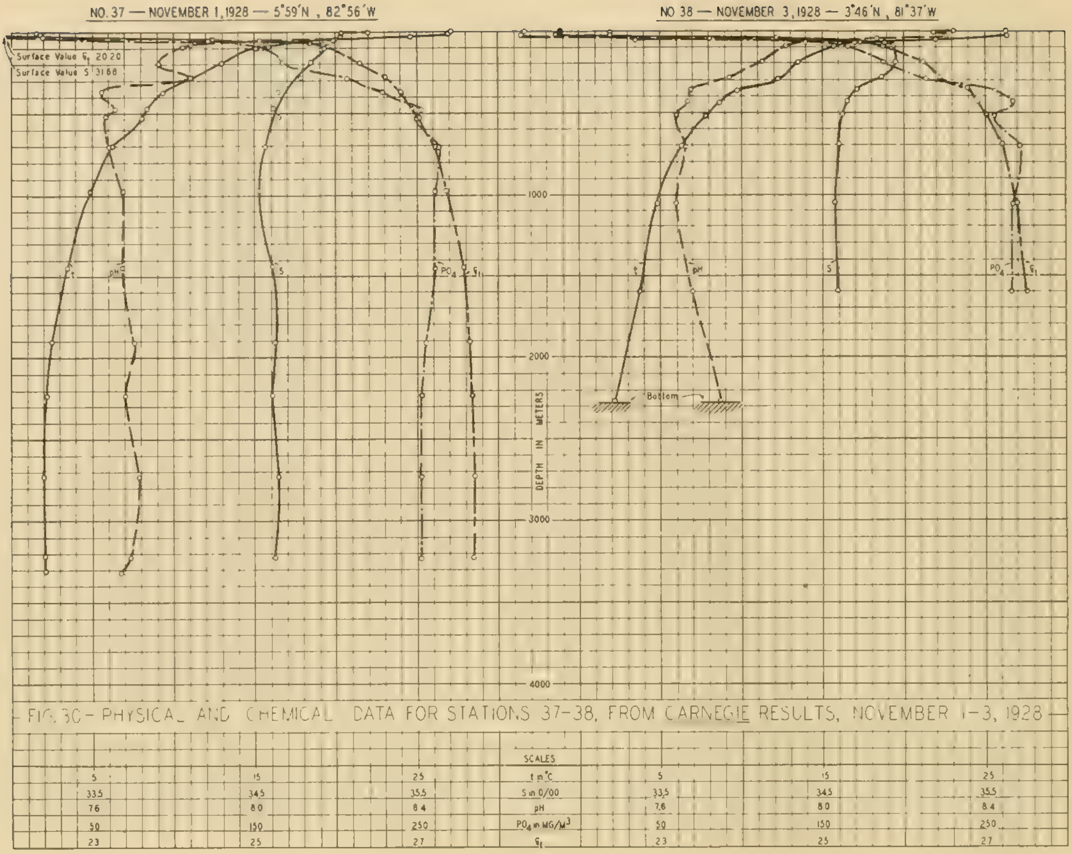


FIG. 30 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 37-38, FROM CARNEGIE RESULTS, NOVEMBER 1-3, 1928

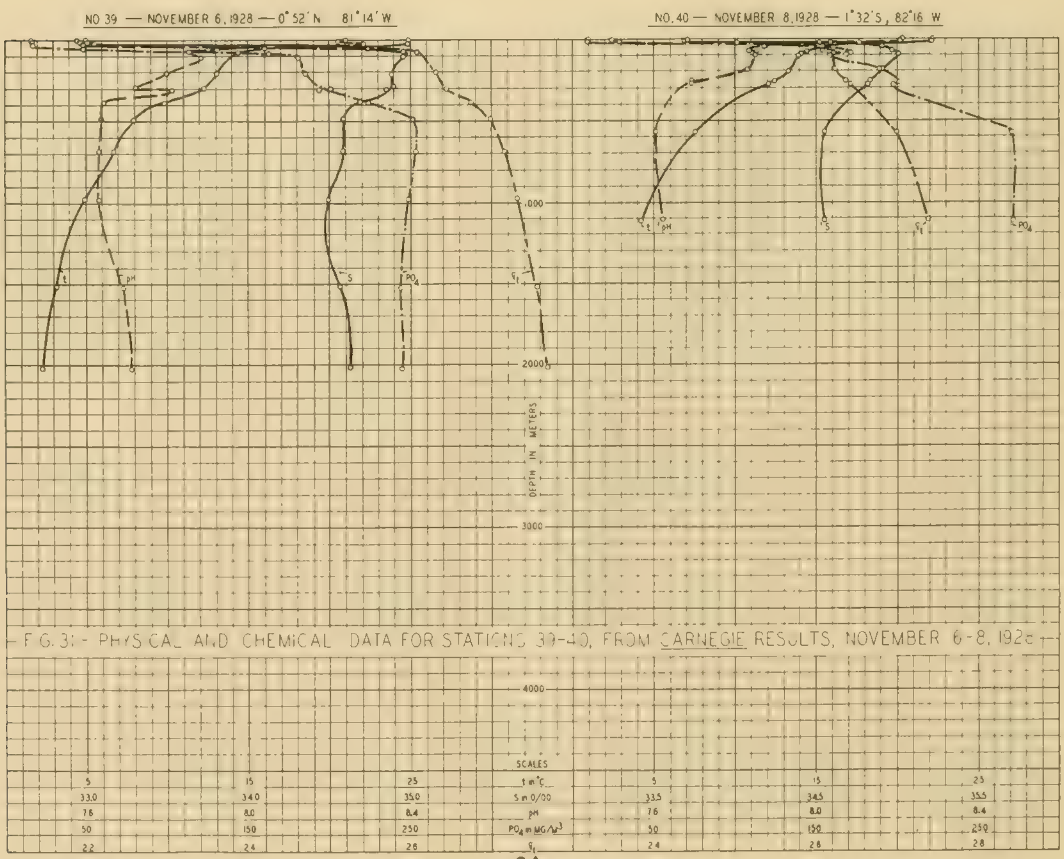


FIG. 31 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 39-40, FROM CARNEGIE RESULTS, NOVEMBER 6-8, 1928

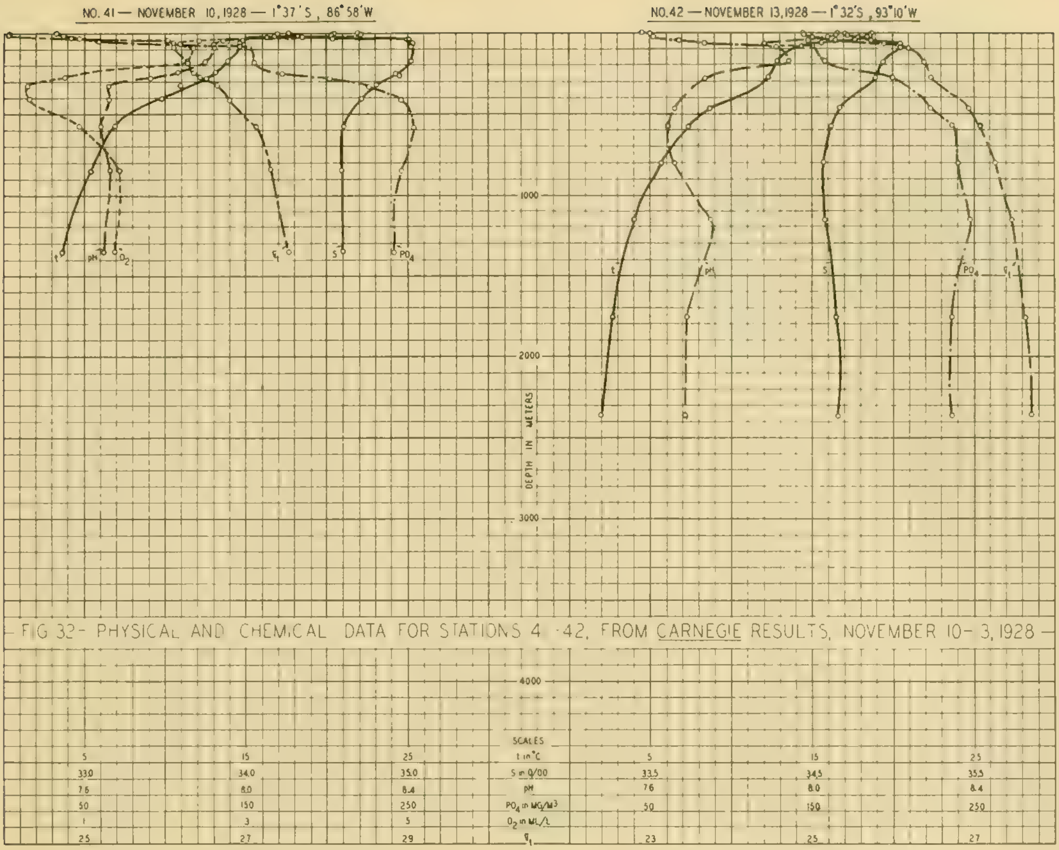


FIG 32- PHYSICAL AND CHEMICAL DATA FOR STATIONS 41-42, FROM CARNEGIE RESULTS, NOVEMBER 10-13, 1928

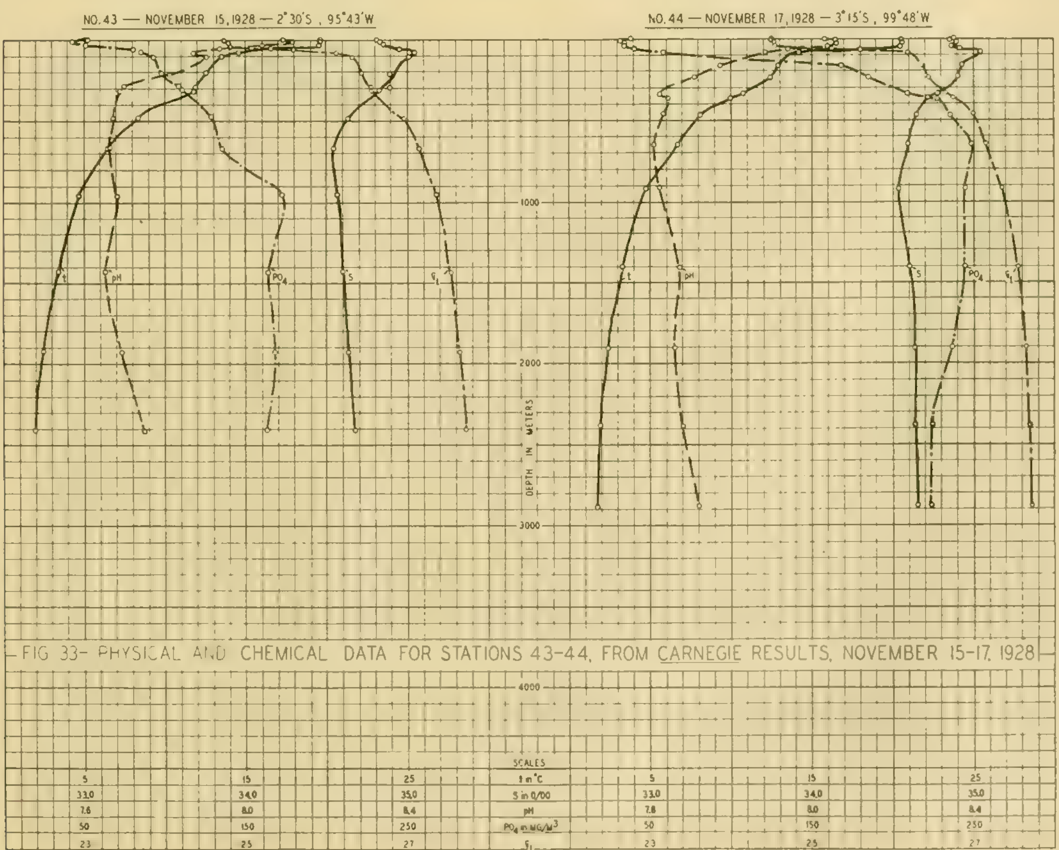


FIG 33- PHYSICAL AND CHEMICAL DATA FOR STATIONS 43-44, FROM CARNEGIE RESULTS, NOVEMBER 15-17, 1928

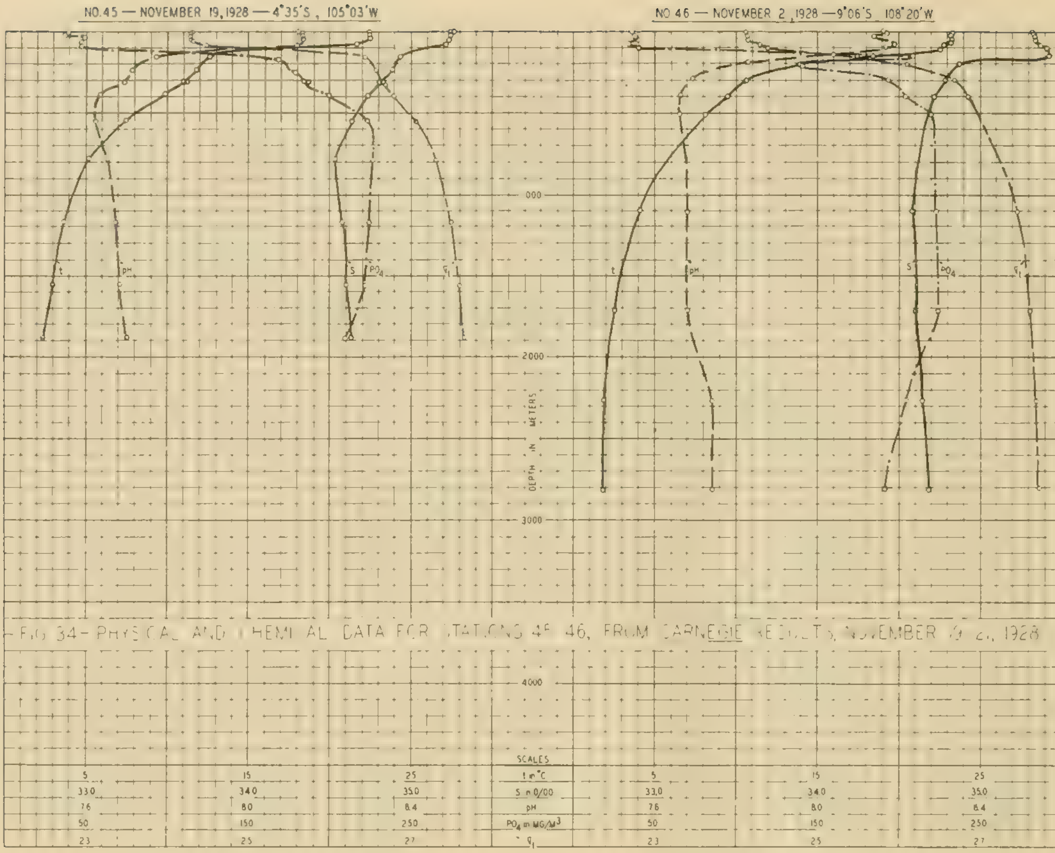


FIG. 34—PHYSICAL AND CHEMICAL DATA FOR STATIONS 45-46, FROM CARNEGIE RESULTS, NOVEMBER 19-21, 1928

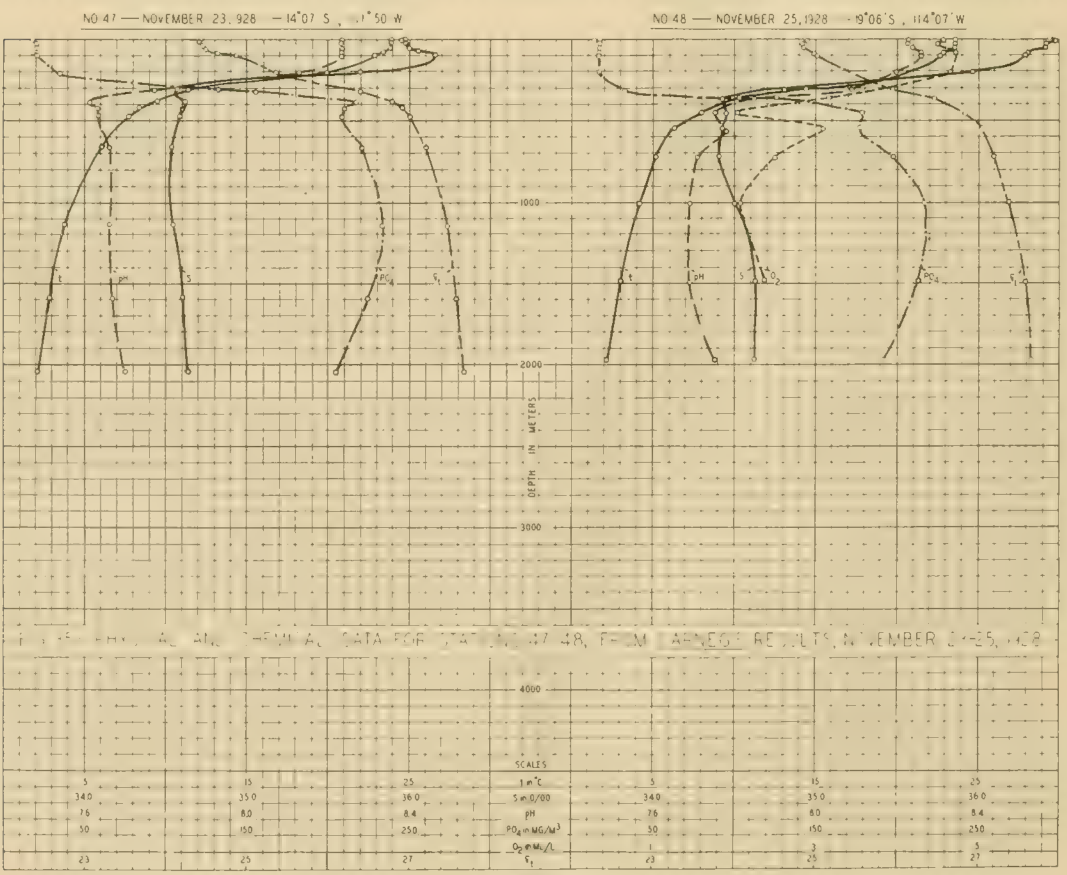


FIG. 35—PHYSICAL AND CHEMICAL DATA FOR STATIONS 47-48, FROM CARNEGIE RESULTS, NOVEMBER 23-25, 1928

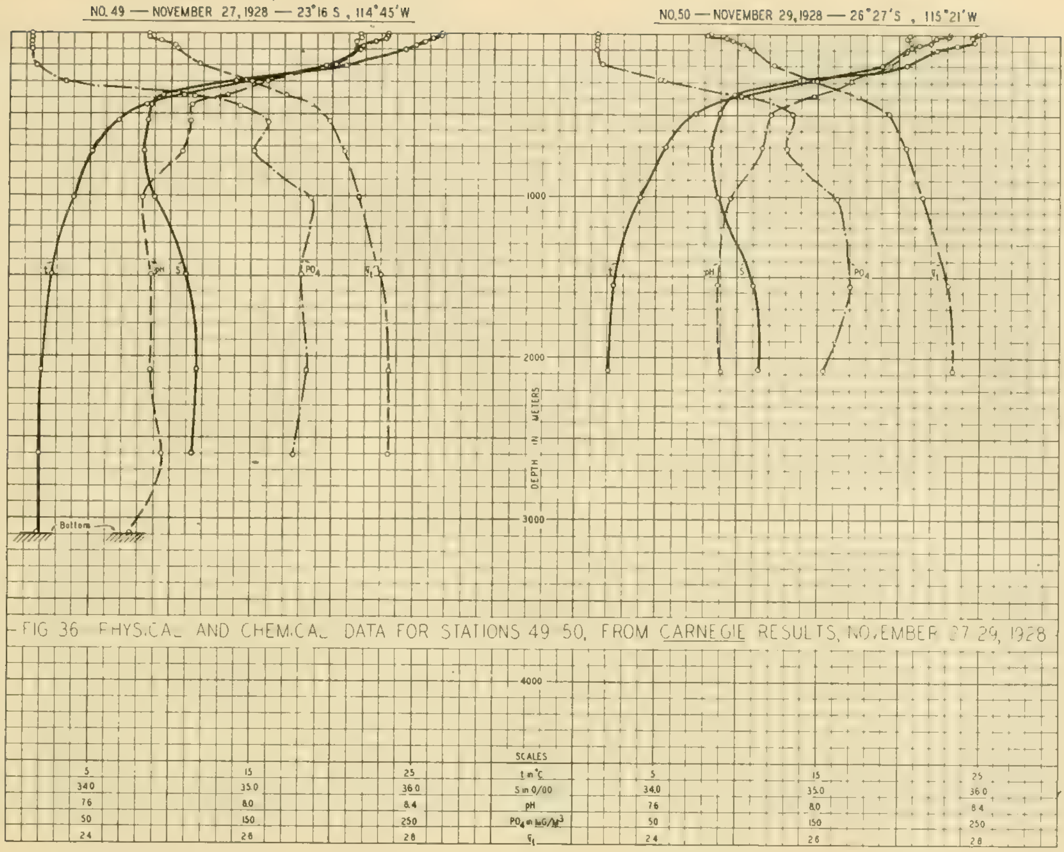


FIG 36 PHYSICAL AND CHEMICAL DATA FOR STATIONS 49-50, FROM CARNEGIE RESULTS, NOVEMBER 27-29, 1928

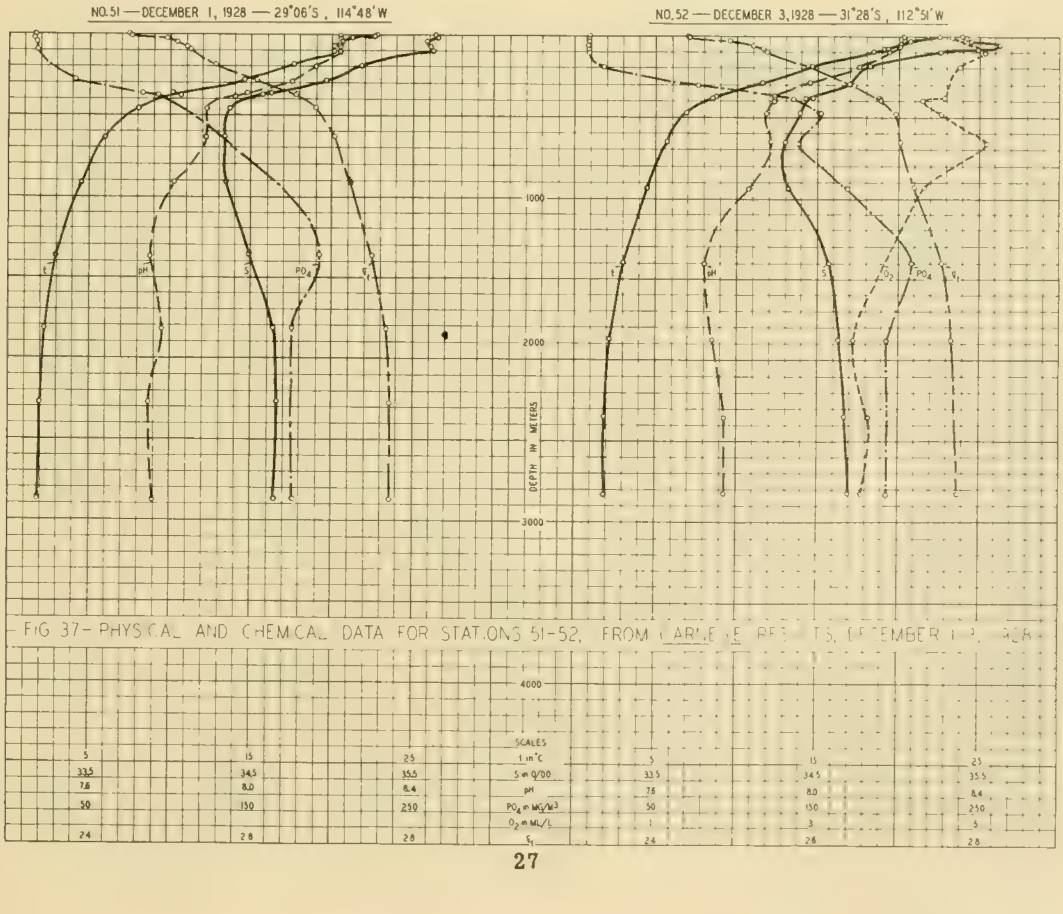


FIG 37- PHYSICAL AND CHEMICAL DATA FOR STATIONS 51-52, FROM CARNEGIE RESULTS, DECEMBER 1-3, 1928

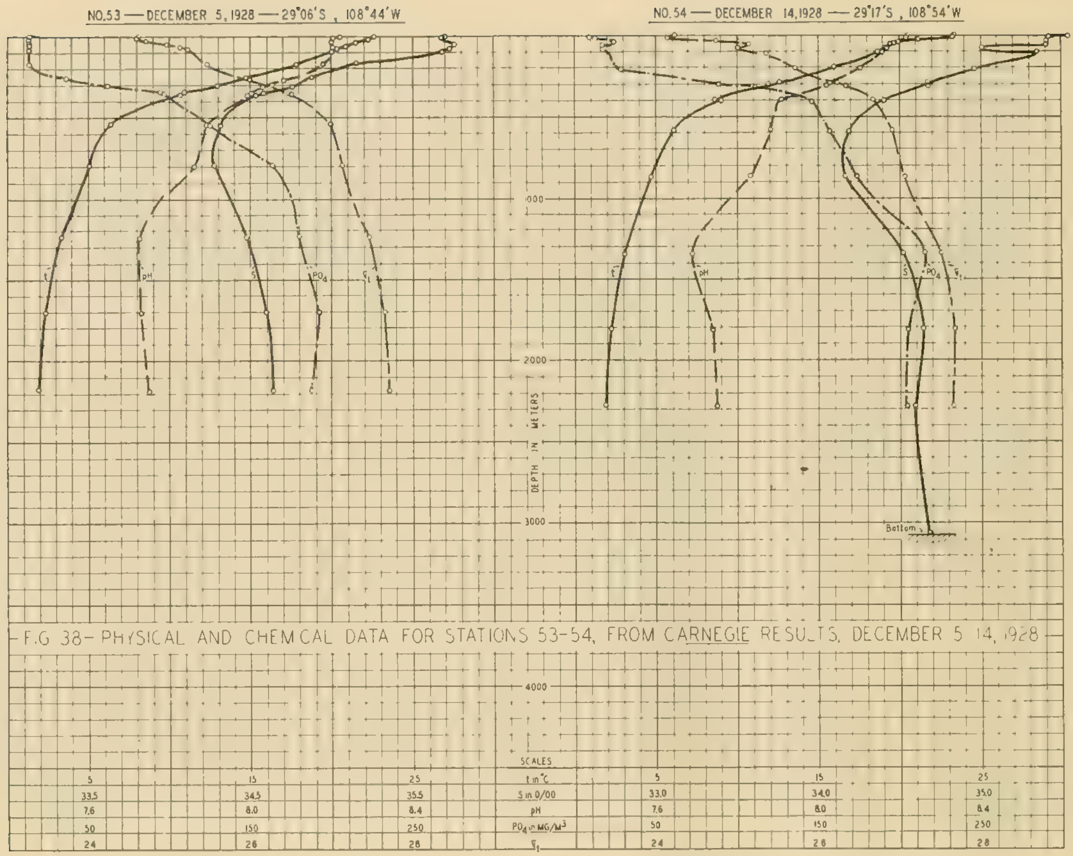


FIG. 38 – PHYSICAL AND CHEMICAL DATA FOR STATIONS 53–54, FROM CARNEGIE RESULTS, DECEMBER 5–14, 1928

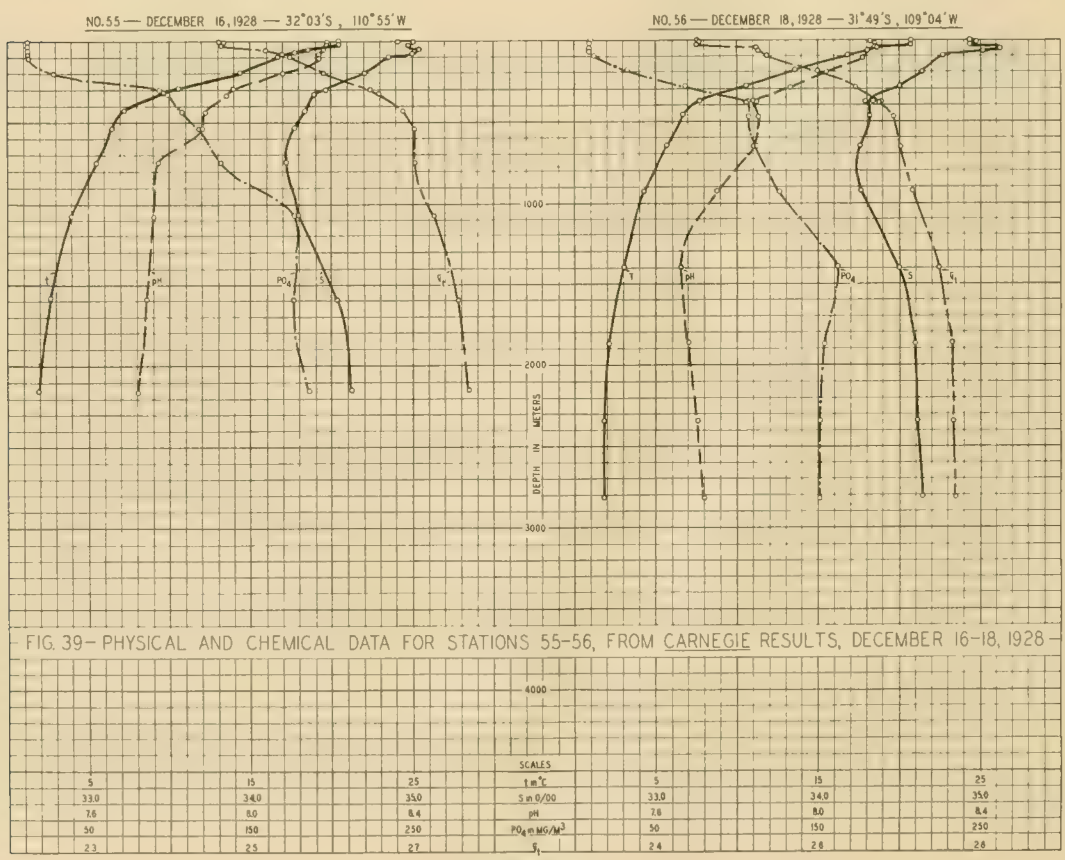


FIG. 39 – PHYSICAL AND CHEMICAL DATA FOR STATIONS 55–56, FROM CARNEGIE RESULTS, DECEMBER 16–18, 1928

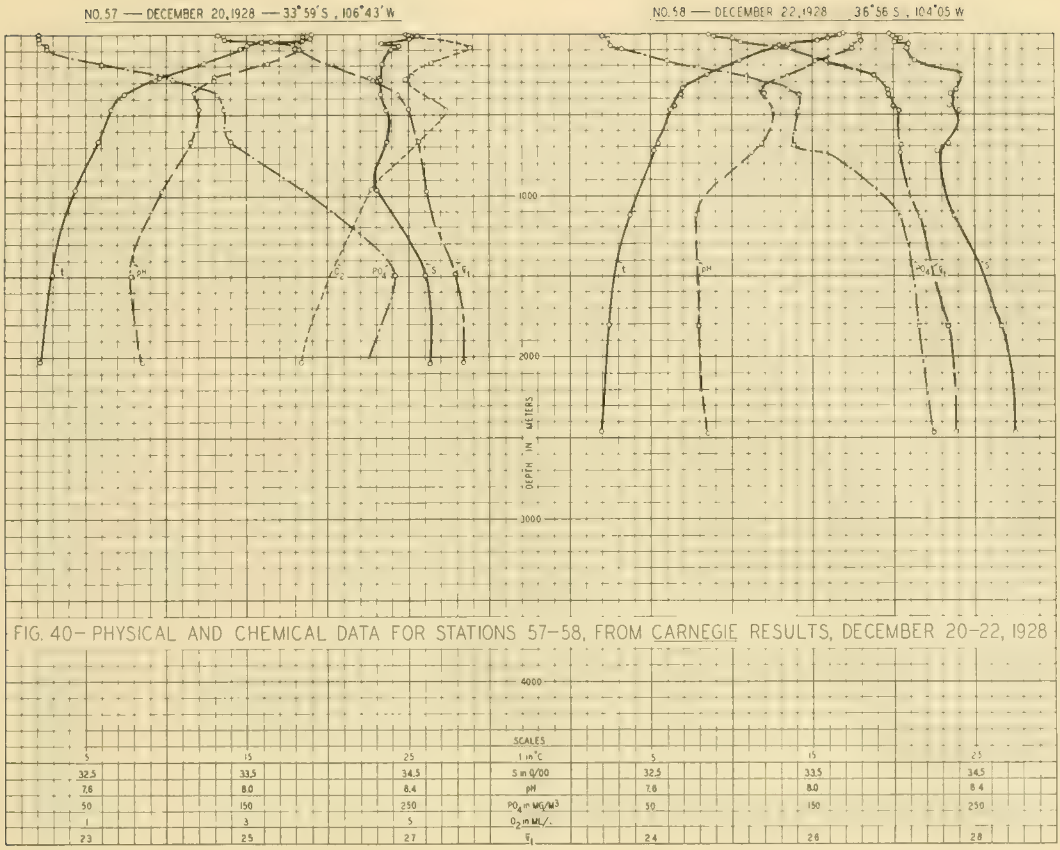


FIG. 40—PHYSICAL AND CHEMICAL DATA FOR STATIONS 57–58, FROM *CARNEGIE* RESULTS, DECEMBER 20–22, 1928

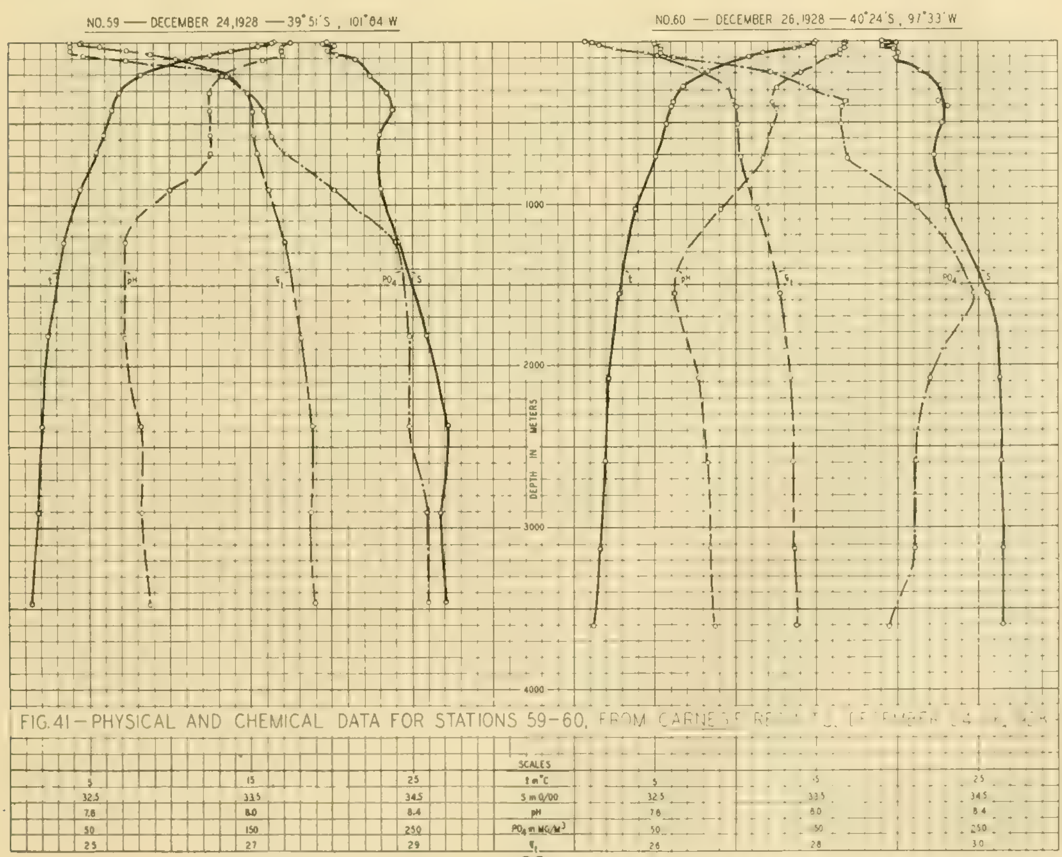


FIG. 41—PHYSICAL AND CHEMICAL DATA FOR STATIONS 59–60, FROM *CARNEGIE* RESULTS, DECEMBER 24–26, 1928

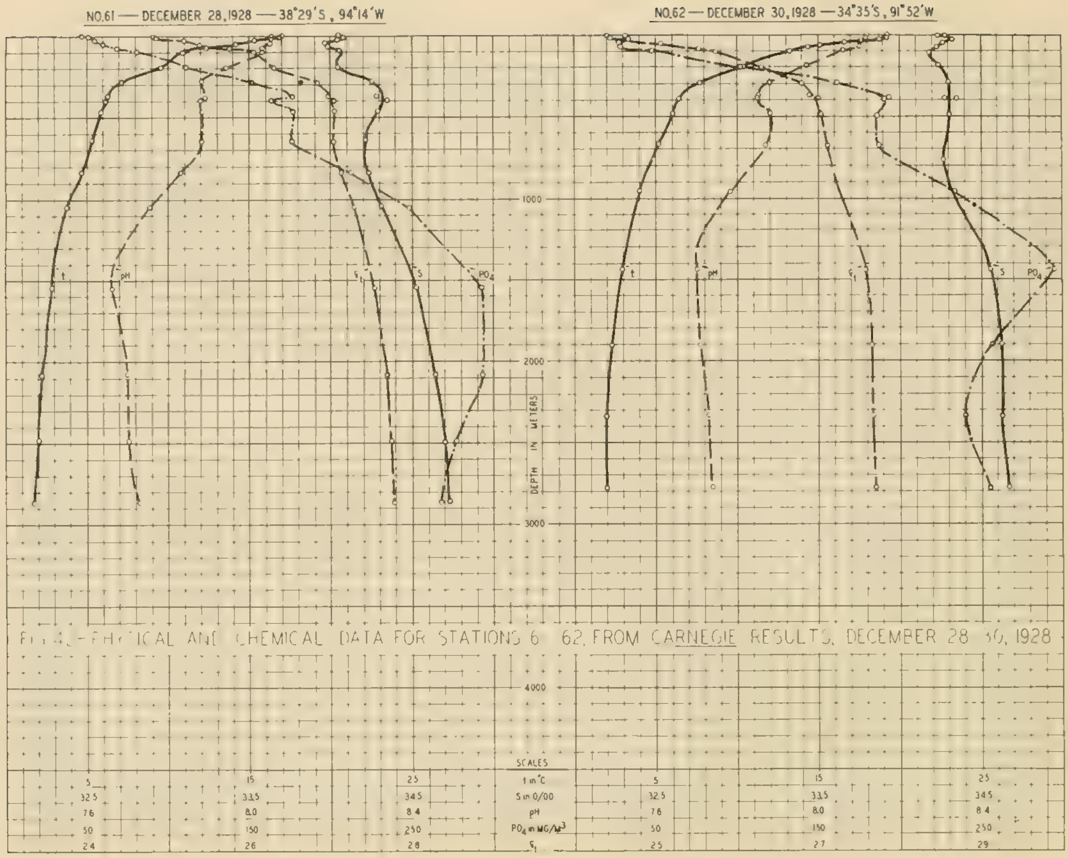


FIG. 42.—PHYSICAL AND CHEMICAL DATA FOR STATIONS 61–62, FROM CARNEGIE RESULTS, DECEMBER 28–30, 1928

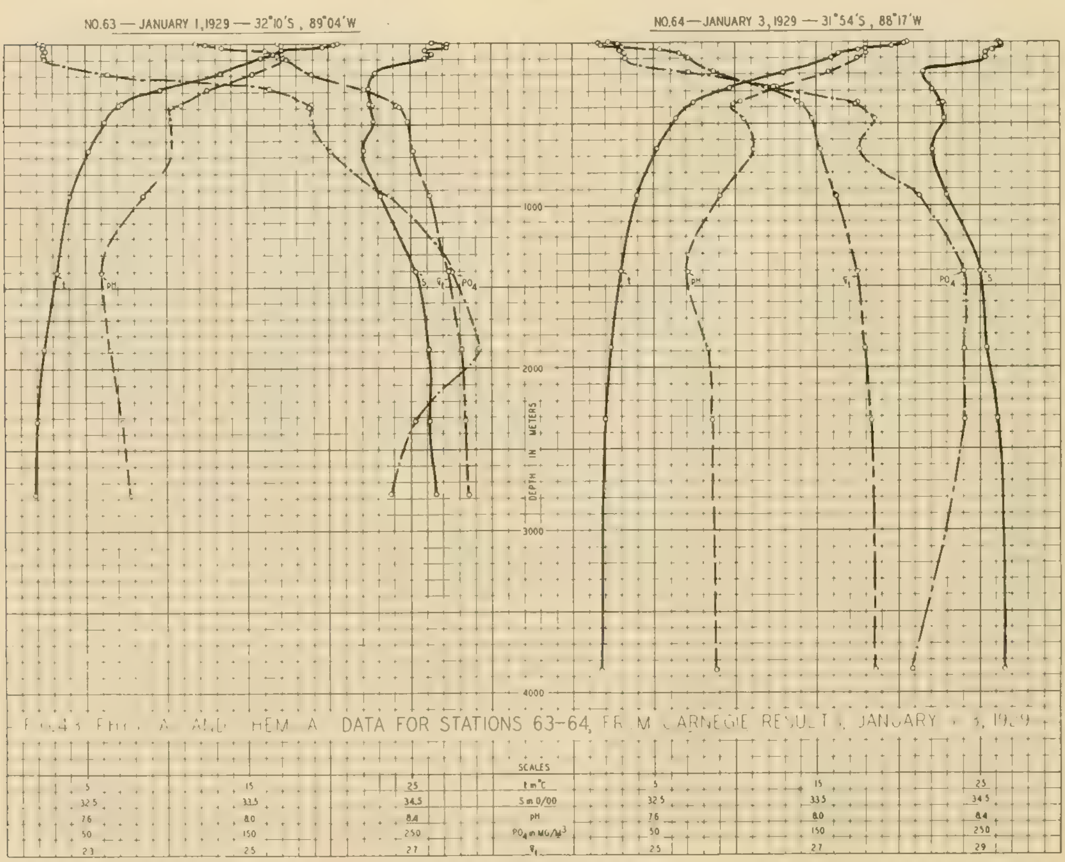


FIG. 43.—PHYSICAL AND CHEMICAL DATA FOR STATIONS 63–64, FROM CARNEGIE RESULTS, JANUARY 1–3, 1929

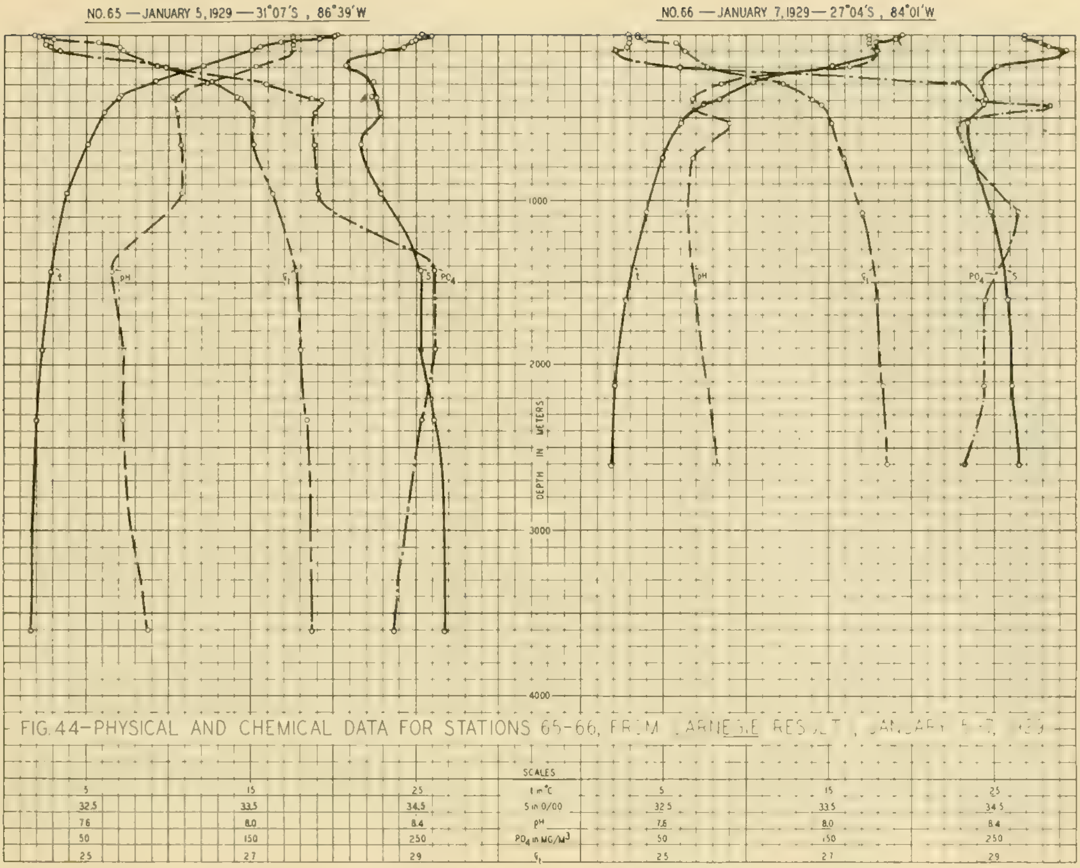


FIG. 44—PHYSICAL AND CHEMICAL DATA FOR STATIONS 65-66, FROM CARNEGIE RESULTS, JANUARY 5-7, 1929

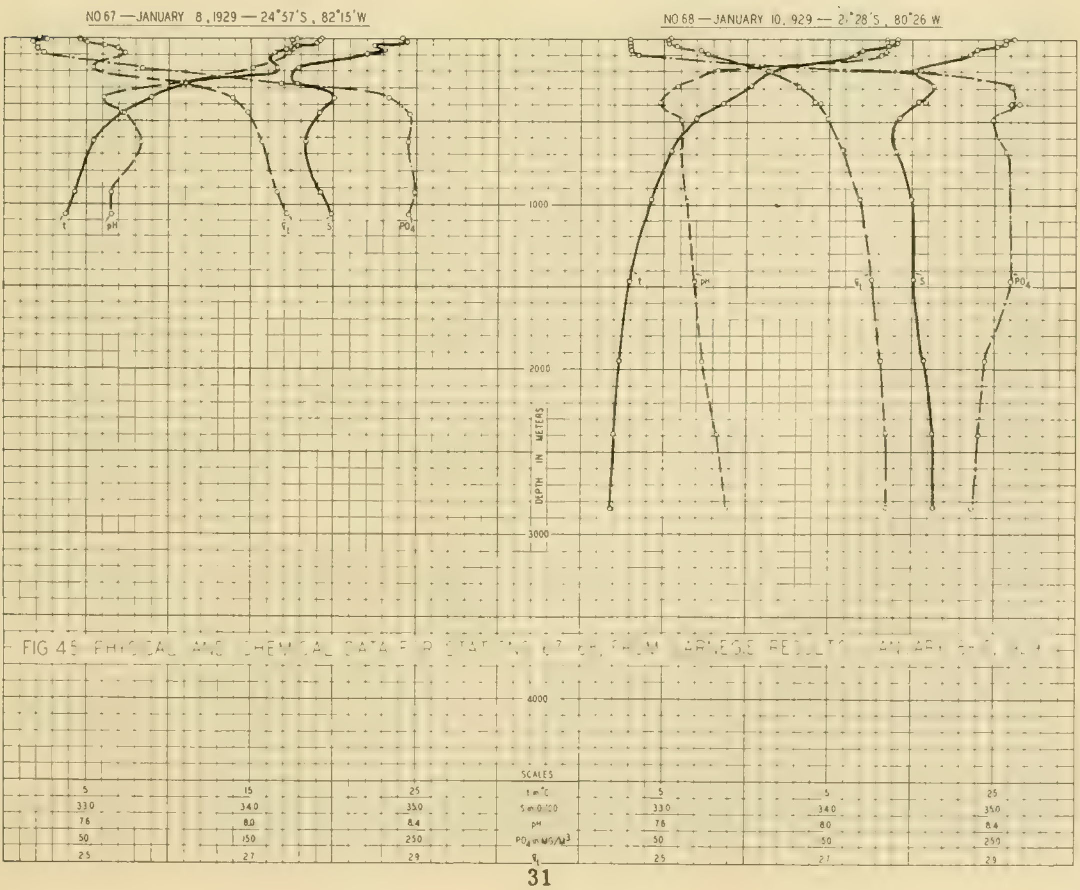


FIG. 45—PHYSICAL AND CHEMICAL DATA FOR STATIONS 67-68, FROM CARNEGIE RESULTS, JANUARY 8-10, 1929

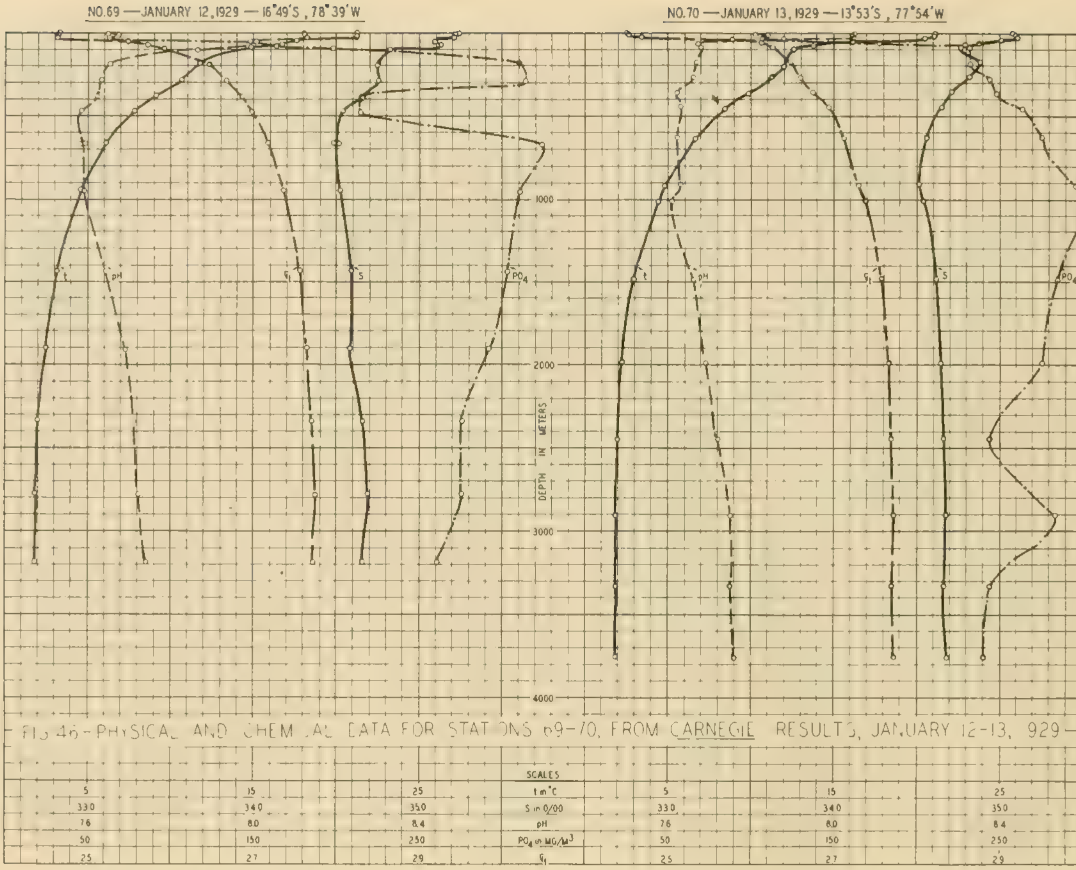


FIG. 46—PHYSICAL AND CHEMICAL DATA FOR STATIONS 69–70, FROM CARNEGIE RESULTS, JANUARY 12-13, 1929

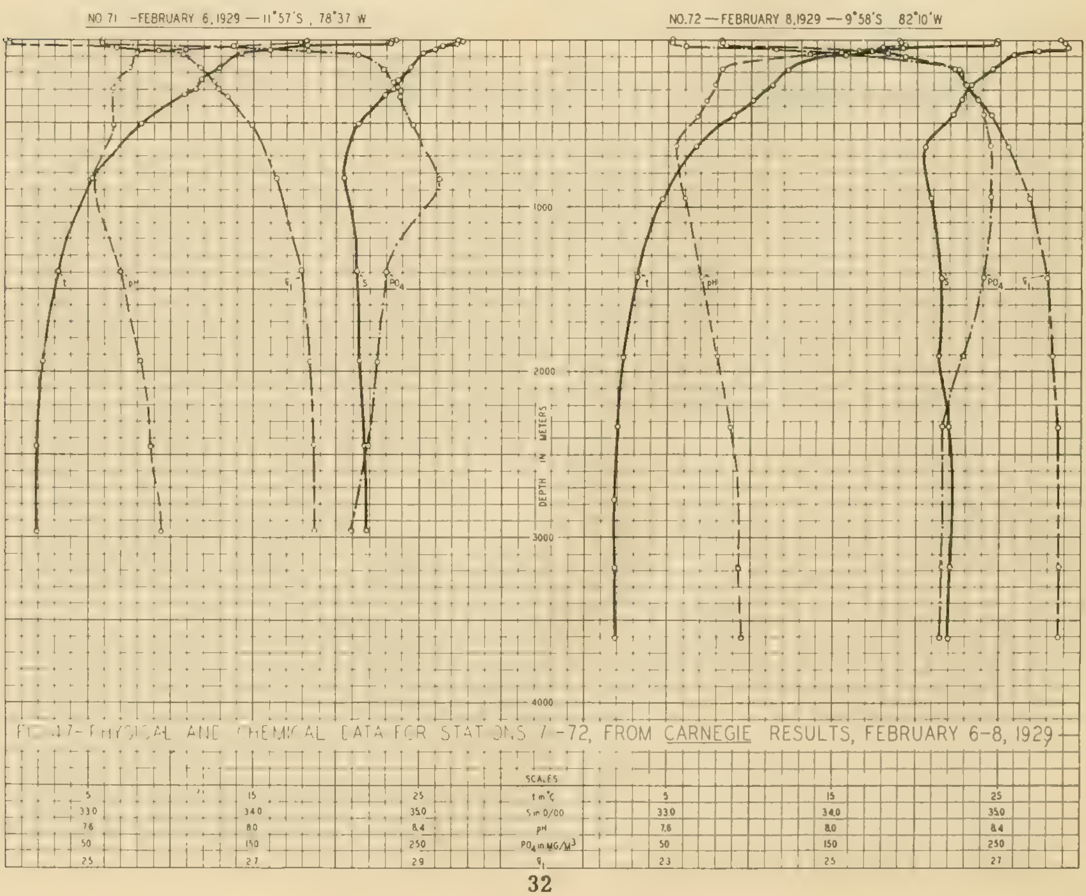


FIG. 47—PHYSICAL AND CHEMICAL DATA FOR STATIONS 71–72, FROM CARNEGIE RESULTS, FEBRUARY 6-8, 1929

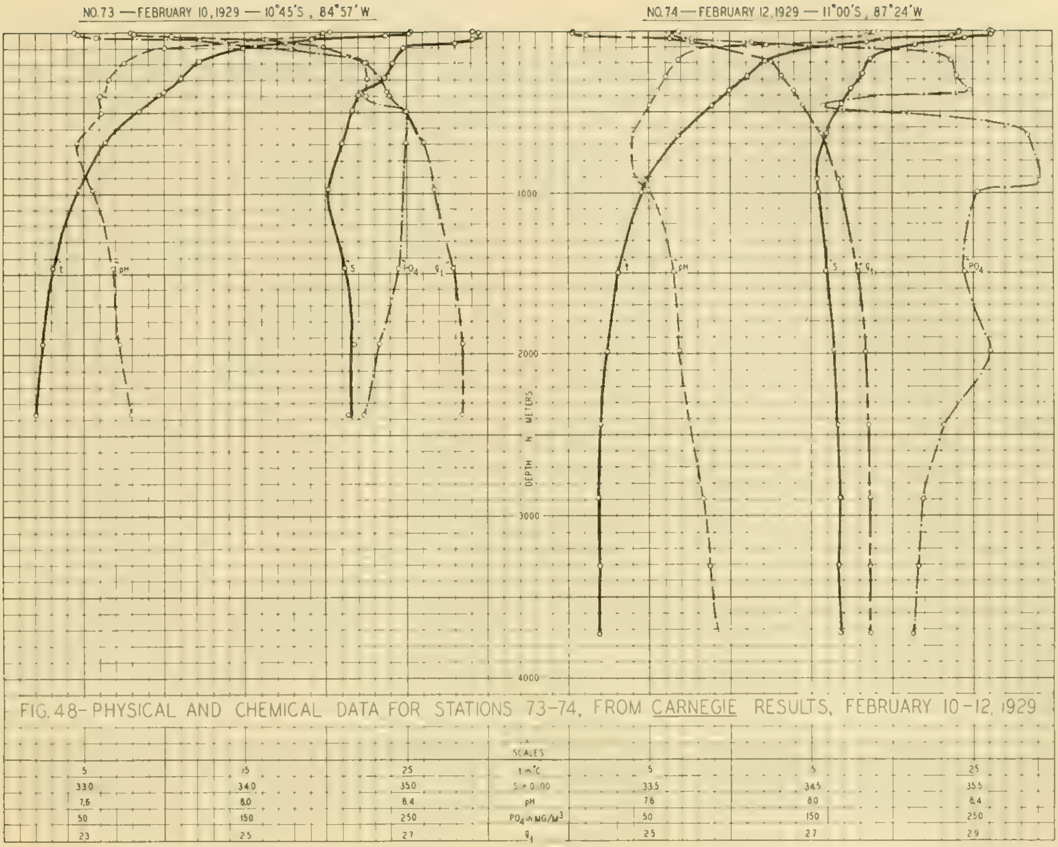


FIG. 48 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 73-74, FROM CARNEGIE RESULTS, FEBRUARY 10-12, 1929

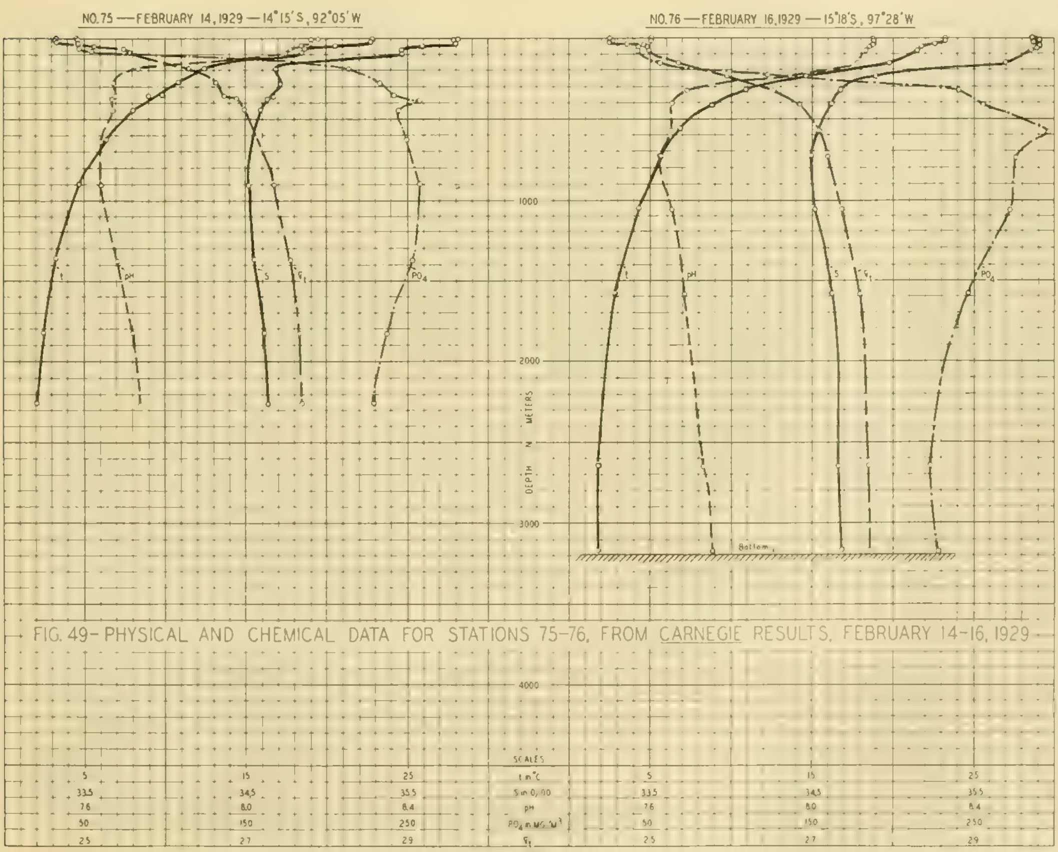


FIG. 49 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 75-76, FROM CARNEGIE RESULTS, FEBRUARY 14-16, 1929

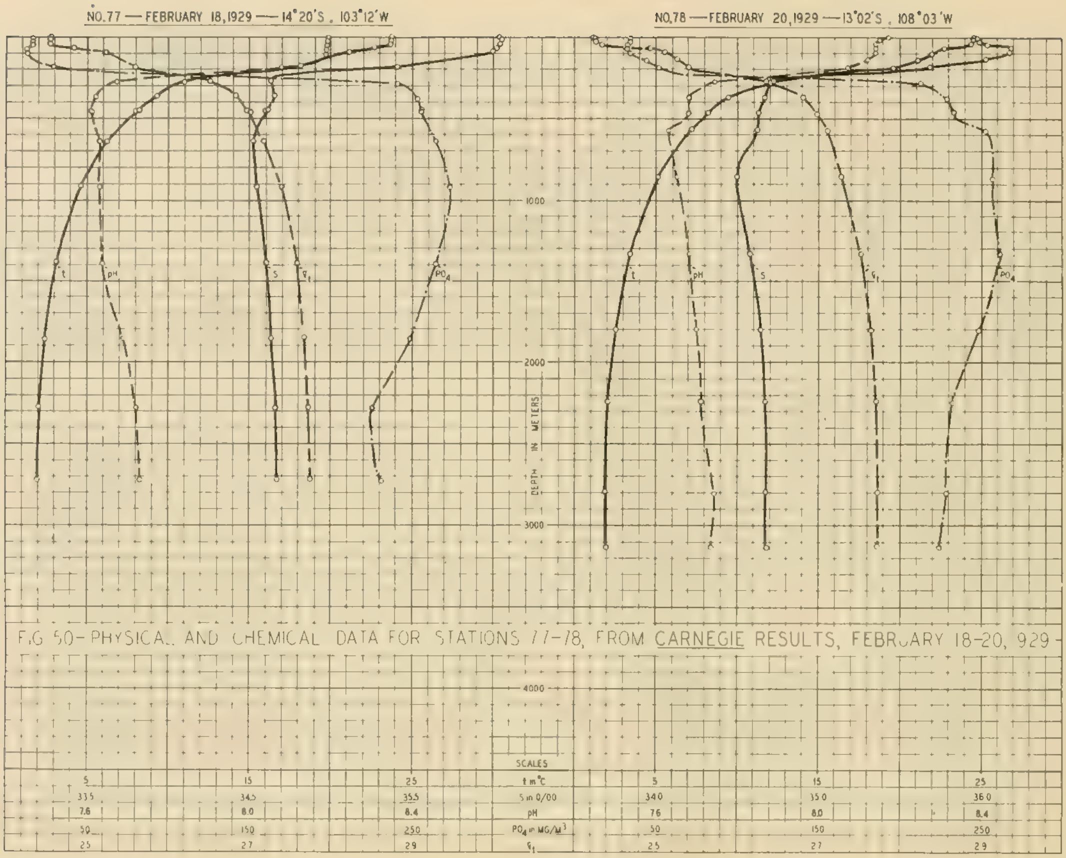


FIG 50 – PHYSICAL AND CHEMICAL DATA FOR STATIONS 77–78, FROM CARNEGIE RESULTS, FEBRUARY 18–20, 1929

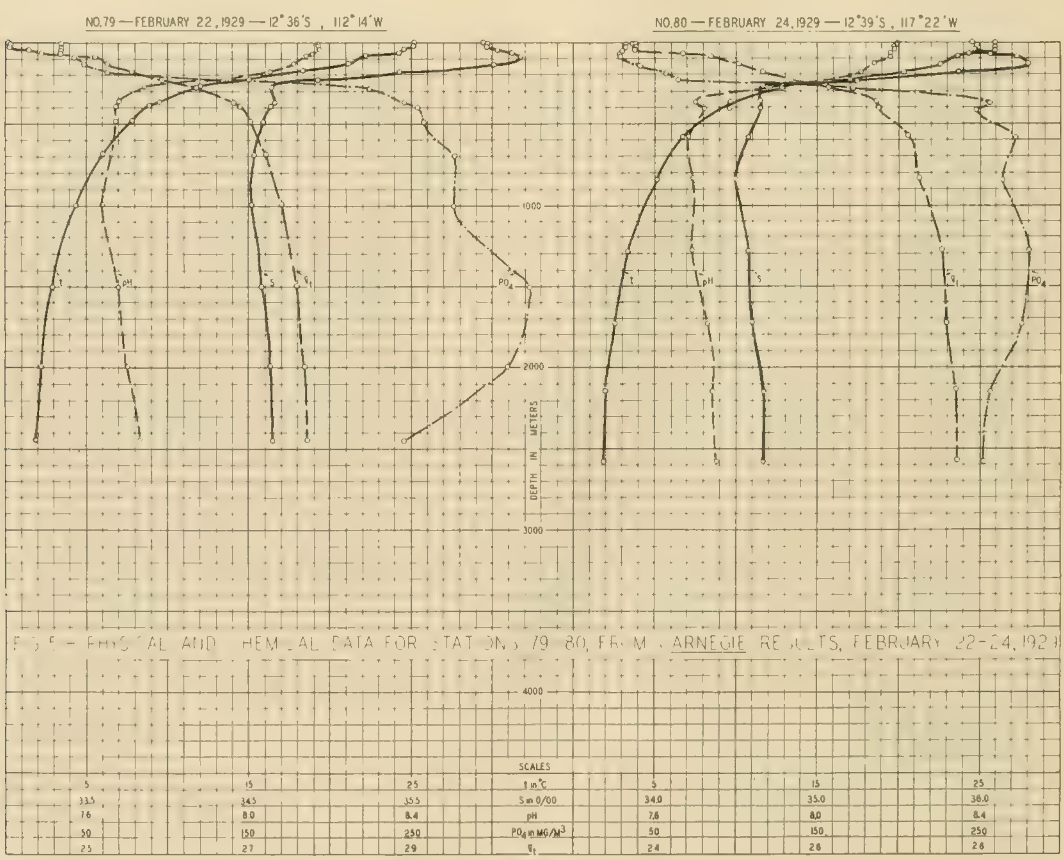


FIG 51 – PHYSICAL AND CHEMICAL DATA FOR STATIONS 79–80, FROM CARNEGIE RESULTS, FEBRUARY 22–24, 1929

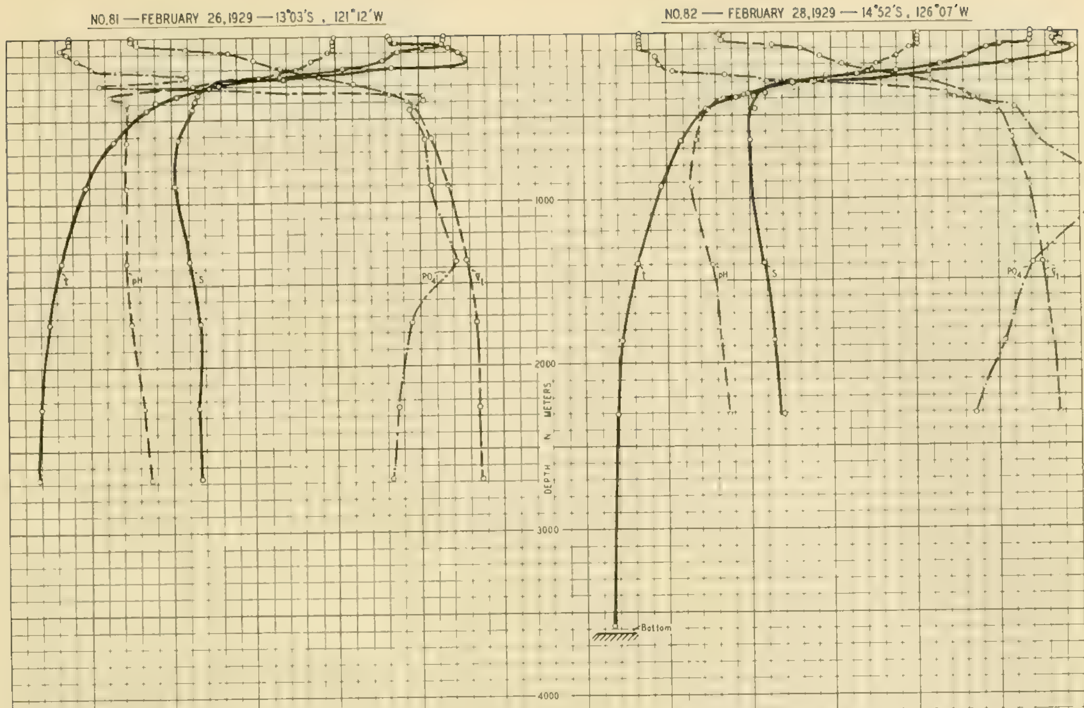


FIG. 52—PHYSICAL AND CHEMICAL DATA FOR STATIONS 81-82, FROM CARNEGIE RESULTS, FEBRUARY 26-28, 1929

			SCALES			
5	15	25	t in °C	5	15	25
34.0	35.0	36.0	S in 0/00	34.0	35.0	36.0
7.6	8.0	8.4	pH	7.6	8.0	8.4
50	150	250	PO_4 in MG/M^3	50	150	250
23	25	27	σ_t	23	25	27

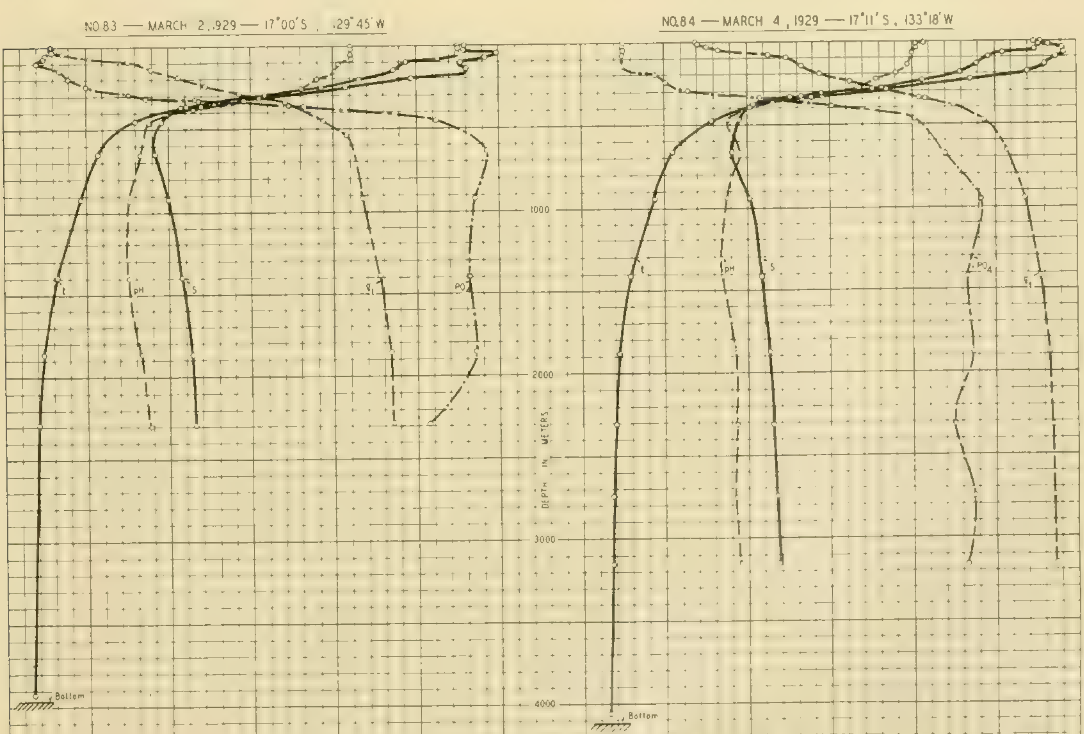


FIG. 53—PHYSICAL AND CHEMICAL DATA FOR STATIONS 83-84, FROM CARNEGIE RESULTS, MARCH 2-4, 1929

			SCALES			
5	15	25	t in °C	5	15	25
34.0	35.0	36.0	S in 0/00	34.0	35.0	36.0
7.6	8.0	8.4	pH	7.6	8.0	8.4
50	150	250	PO_4 in MG/M^3	50	150	250
24	26	28	σ_t	23	25	27

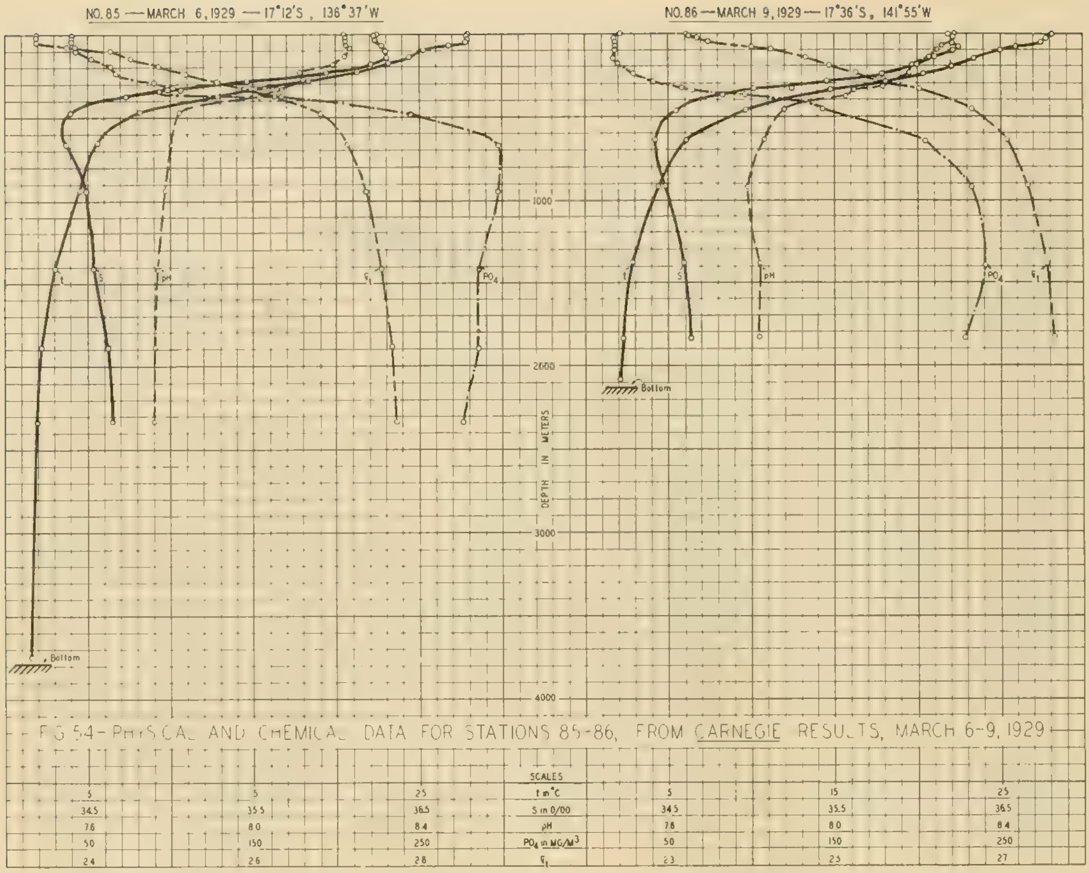


FIG. 54 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 85-86, FROM CARNEGIE RESULTS, MARCH 6-9, 1929

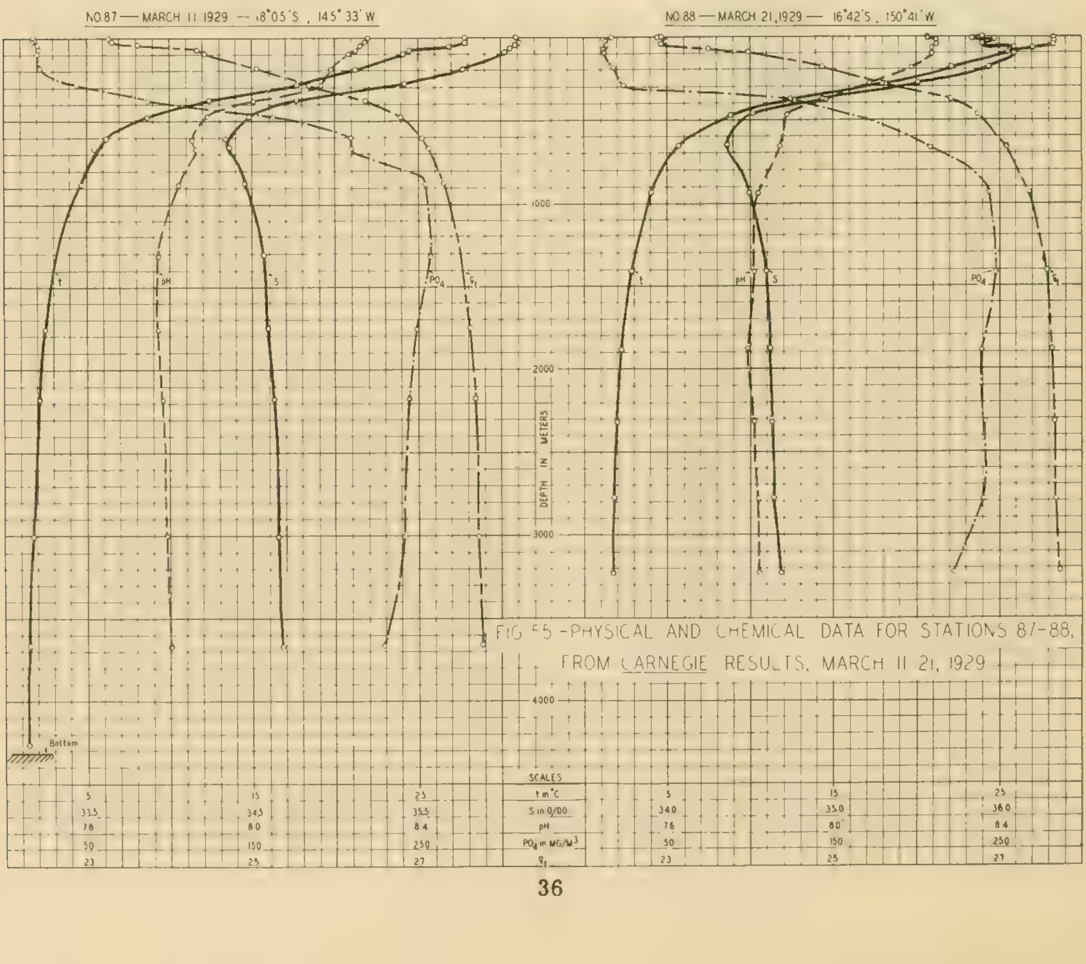


FIG. 55 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 87-88, FROM CARNEGIE RESULTS, MARCH 11-21, 1929

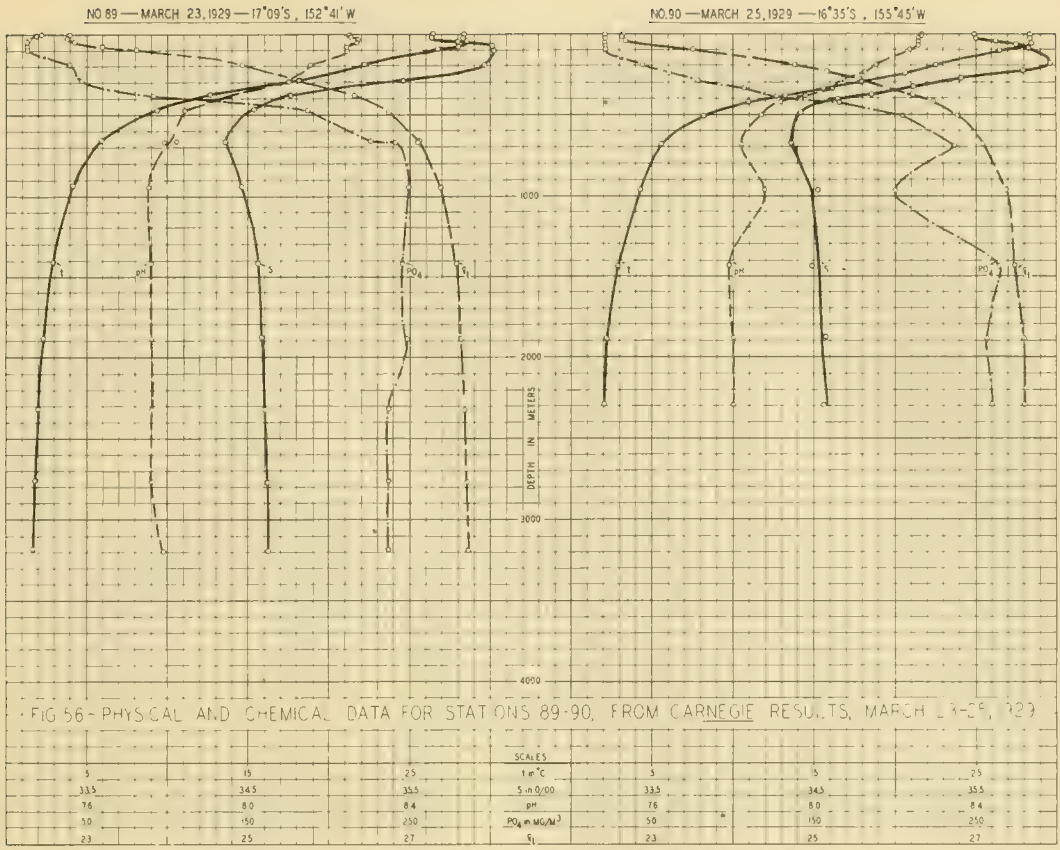


FIG. 56 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 89-90, FROM CARNEGIE RESULTS, MARCH 23-25, 1929

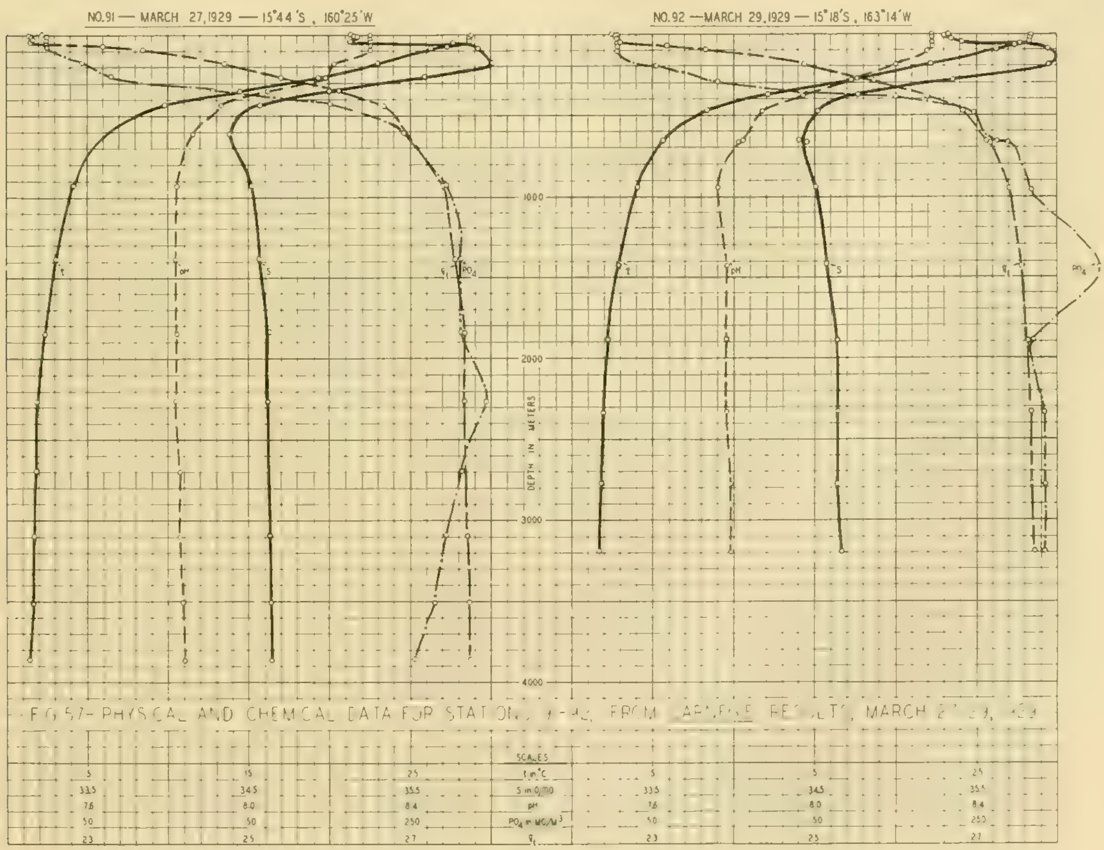


FIG. 57 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 91-92, FROM CARNEGIE RESULTS, MARCH 27-29, 1929

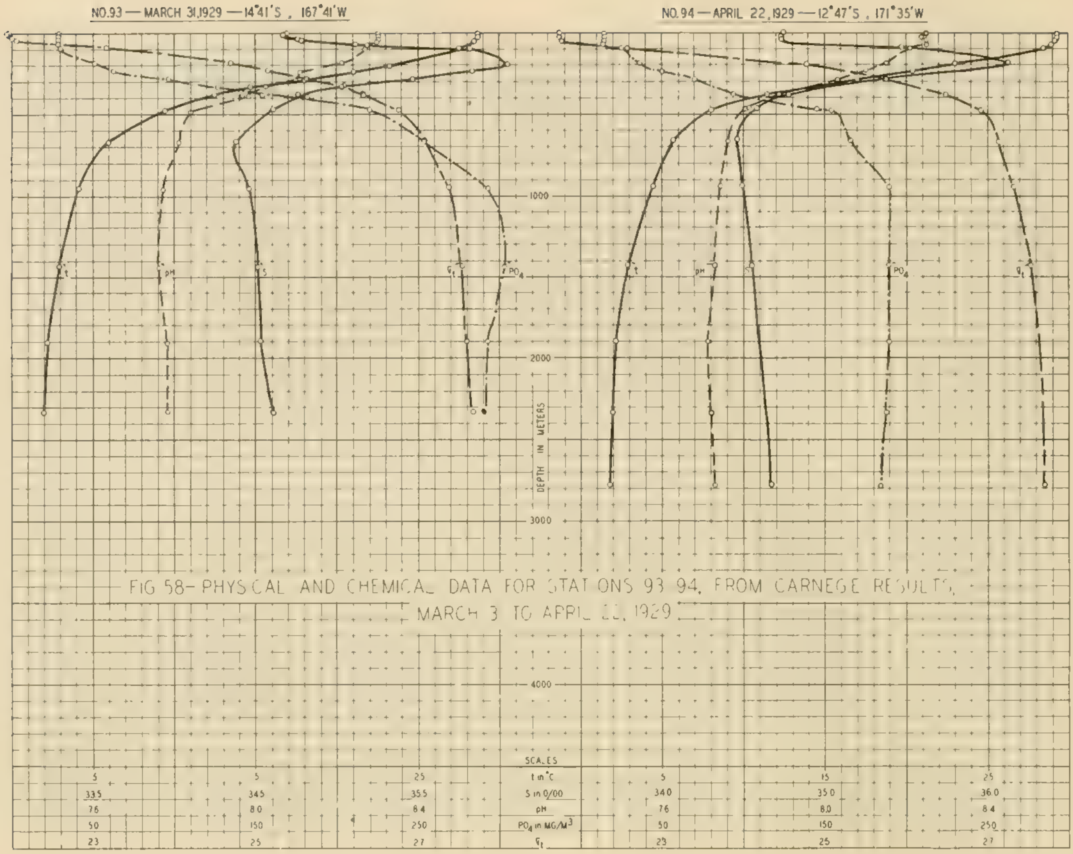


FIG 58- PHYSICAL AND CHEMICAL DATA FOR STATIONS 93 94, FROM CARNEGIE RESULTS, MARCH 3 TO APRIL 22, 1929

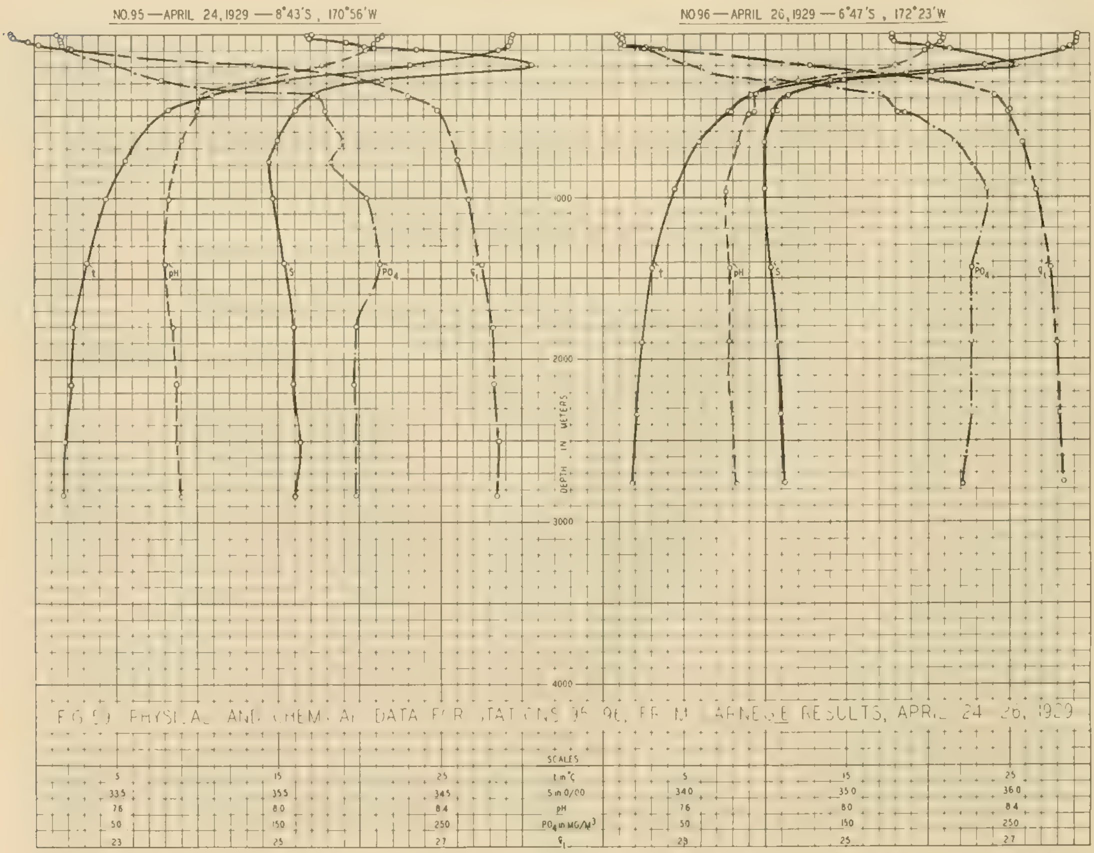


FIG 59 PHYSICAL AND CHEMICAL DATA FOR STATIONS 95 96, FROM CARNEGIE RESULTS, APRIL 24 - 26, 1929

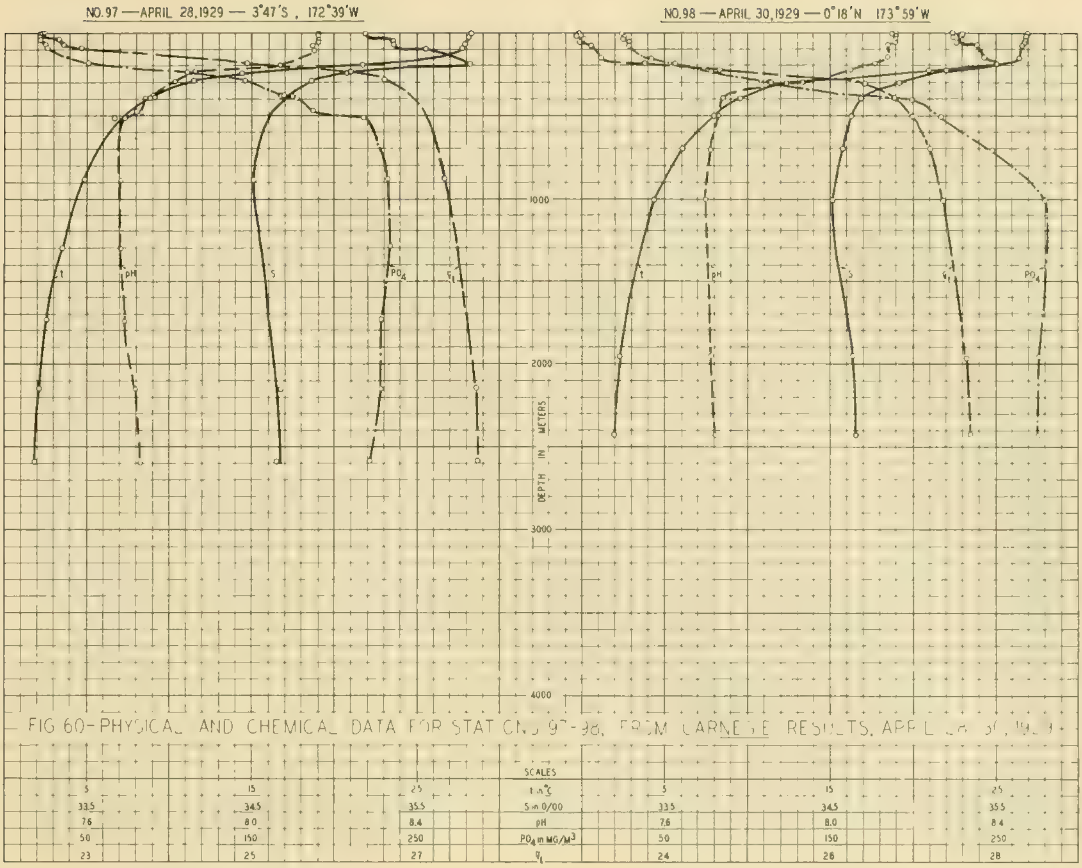


FIG. 60—PHYSICAL AND CHEMICAL DATA FOR STATIONS 97-98, FROM CARNEGIE RESULTS, APRIL 28-30, 1929

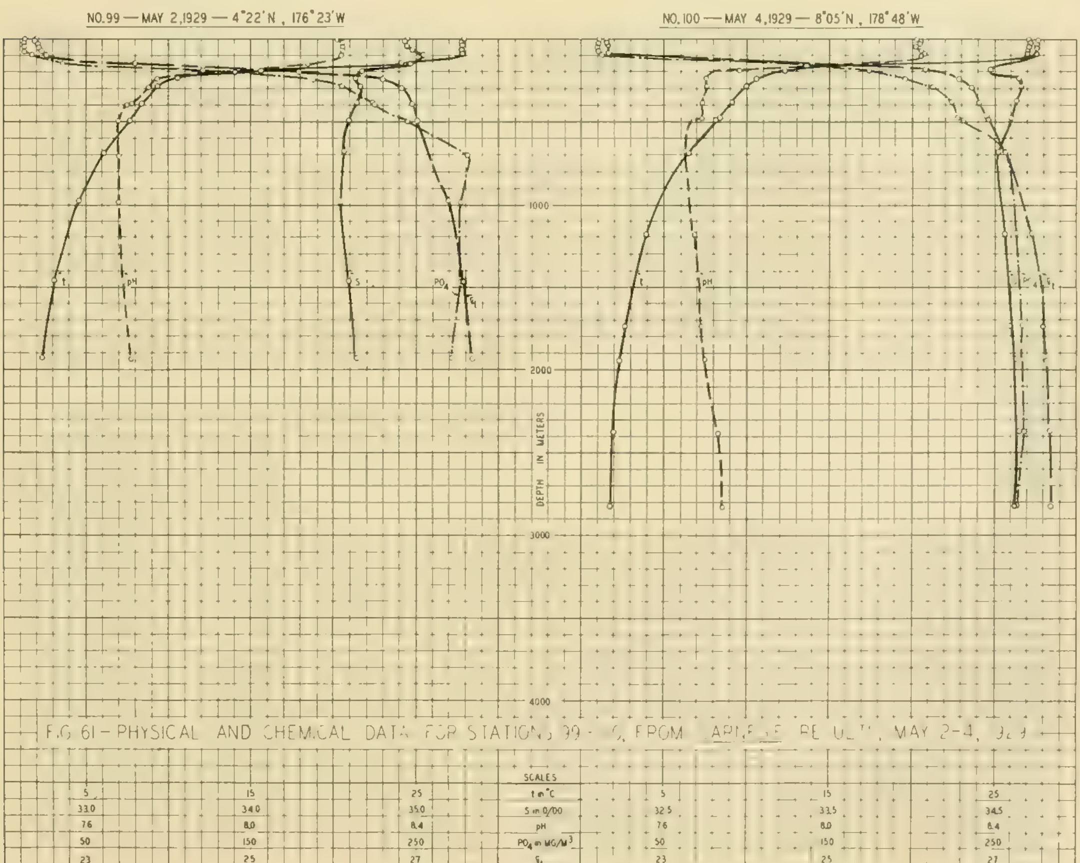


FIG. 61—PHYSICAL AND CHEMICAL DATA FOR STATIONS 99-100, FROM CARNEGIE RESULTS, MAY 2-4, 1929

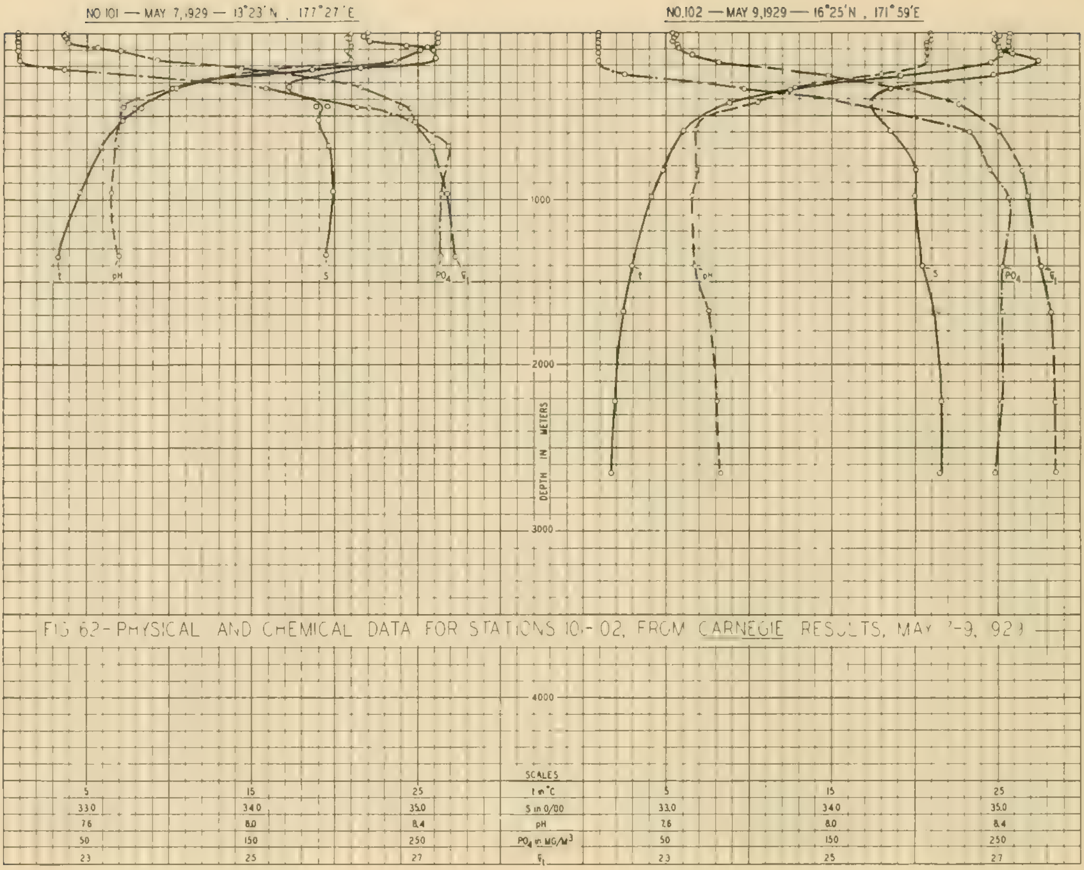


FIG 62 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 101-102, FROM CARNEGIE RESULTS, MAY 7-9, 1929

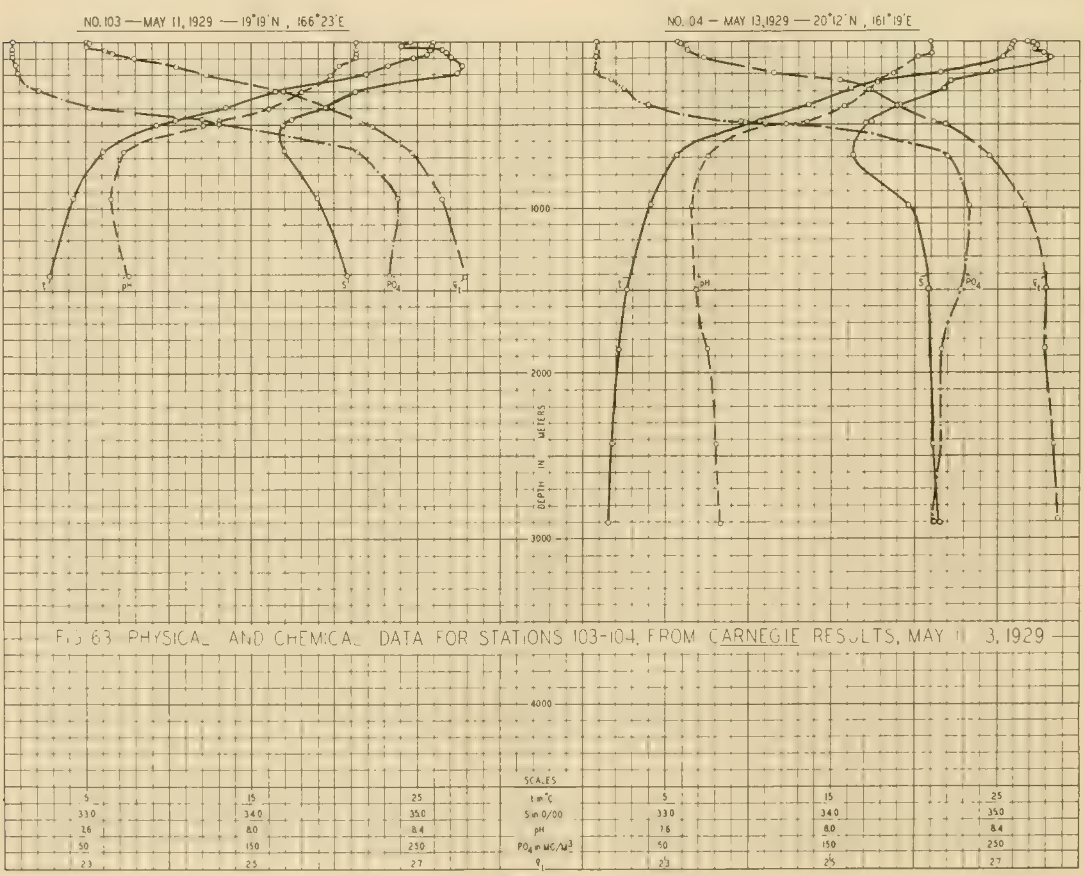


FIG 63 PHYSICAL AND CHEMICAL DATA FOR STATIONS 103-104, FROM CARNEGIE RESULTS, MAY 11-13, 1929

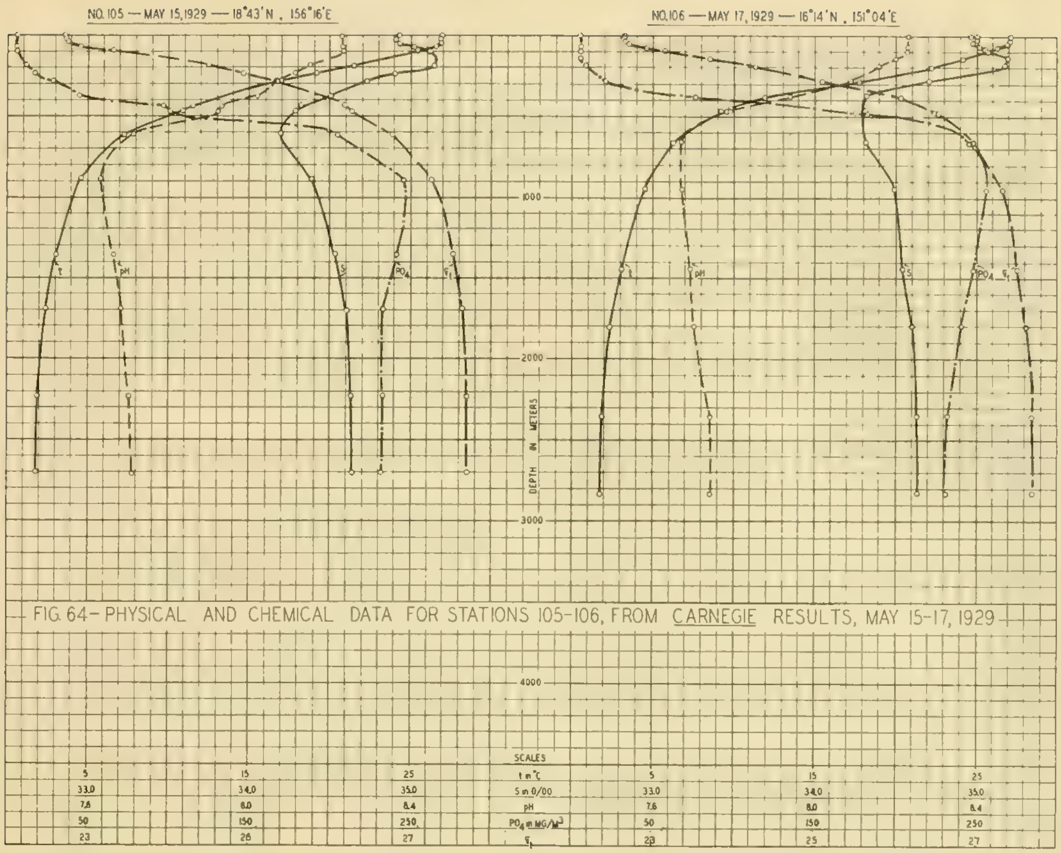


FIG. 64 – PHYSICAL AND CHEMICAL DATA FOR STATIONS 105-106, FROM CARNEGIE RESULTS, MAY 15-17, 1929

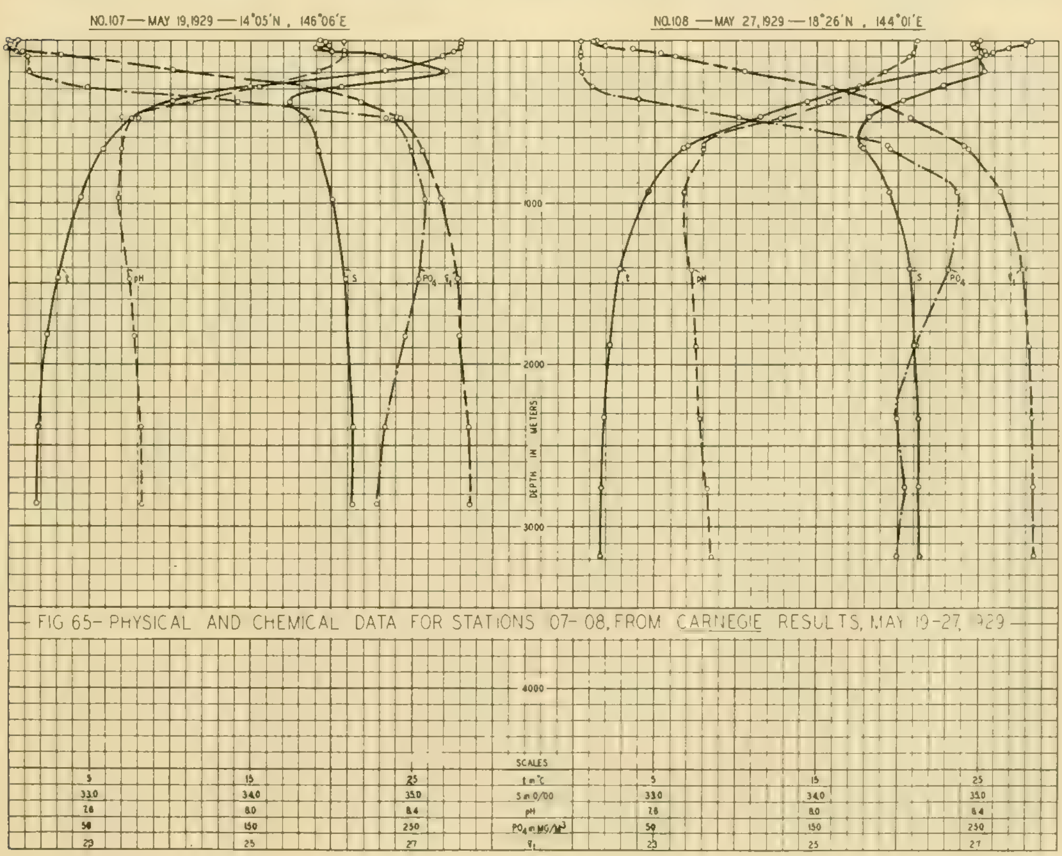


FIG. 65 – PHYSICAL AND CHEMICAL DATA FOR STATIONS 107-108, FROM CARNEGIE RESULTS, MAY 19-27, 1929

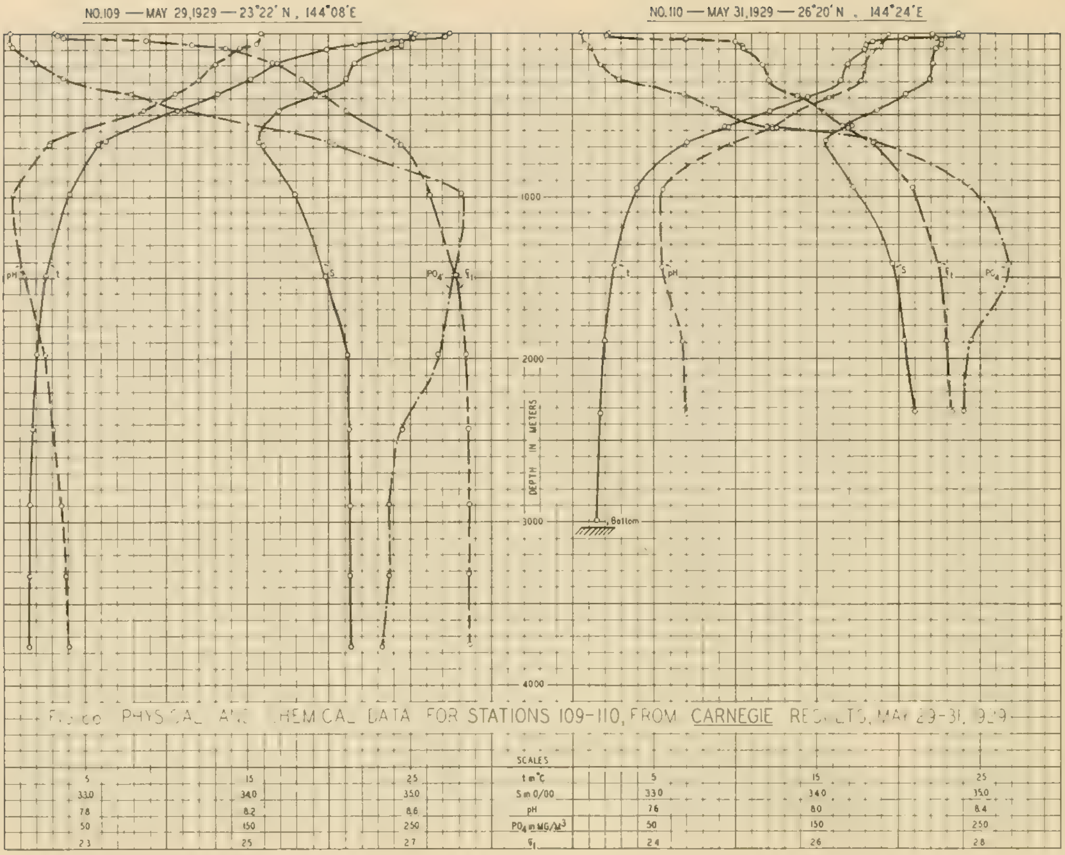


Fig. 66. PHYSICAL AND CHEMICAL DATA FOR STATIONS 109-110, FROM CARNEGIE RESULTS, MAY 29-31, 1929

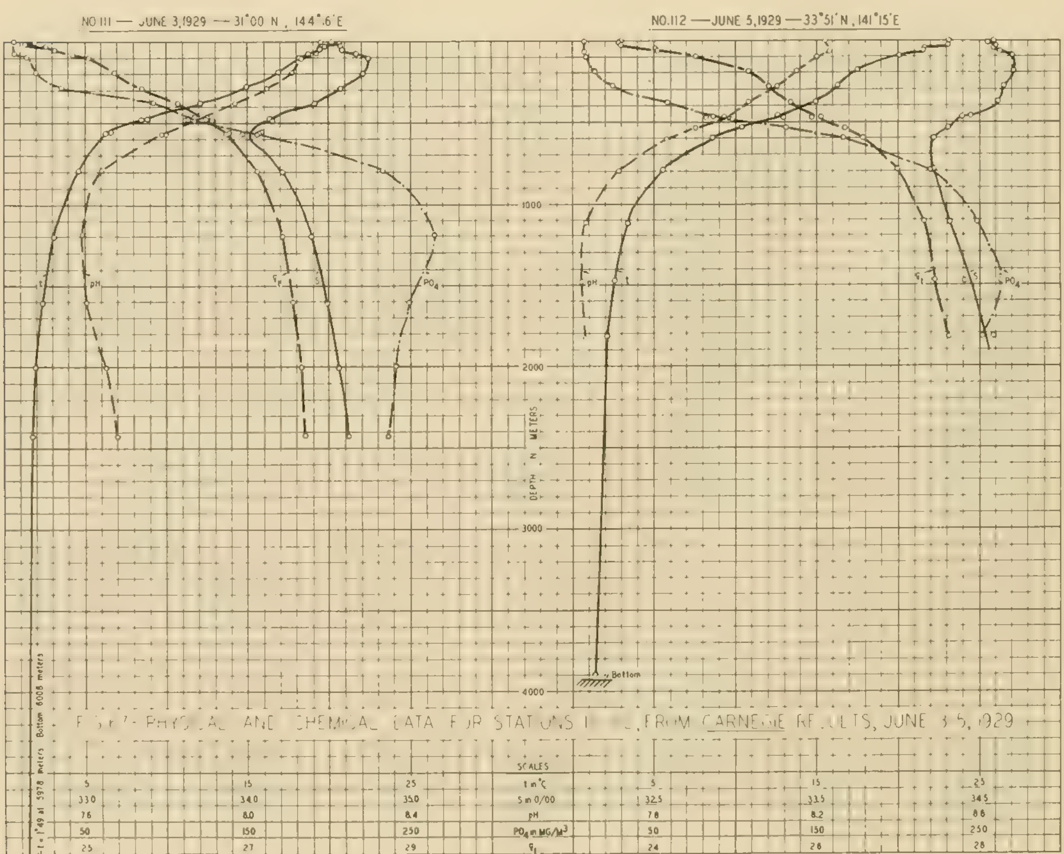


Fig. 67. PHYSICAL AND CHEMICAL DATA FOR STATIONS 111-112, FROM CARNEGIE RESULTS, JUNE 3-5, 1929

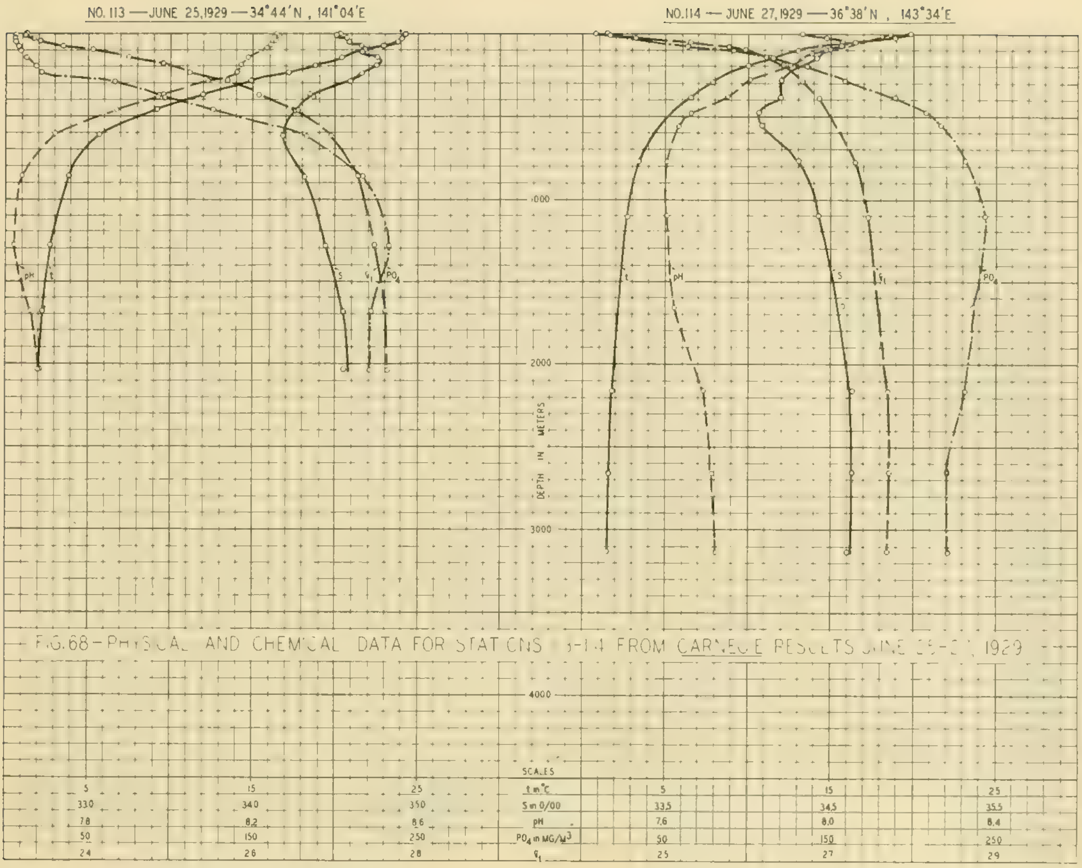


FIG. 68 – PHYSICAL AND CHEMICAL DATA FOR STATIONS 113-114 FROM CARNEGIE RESULTS JUNE 25-27, 1929

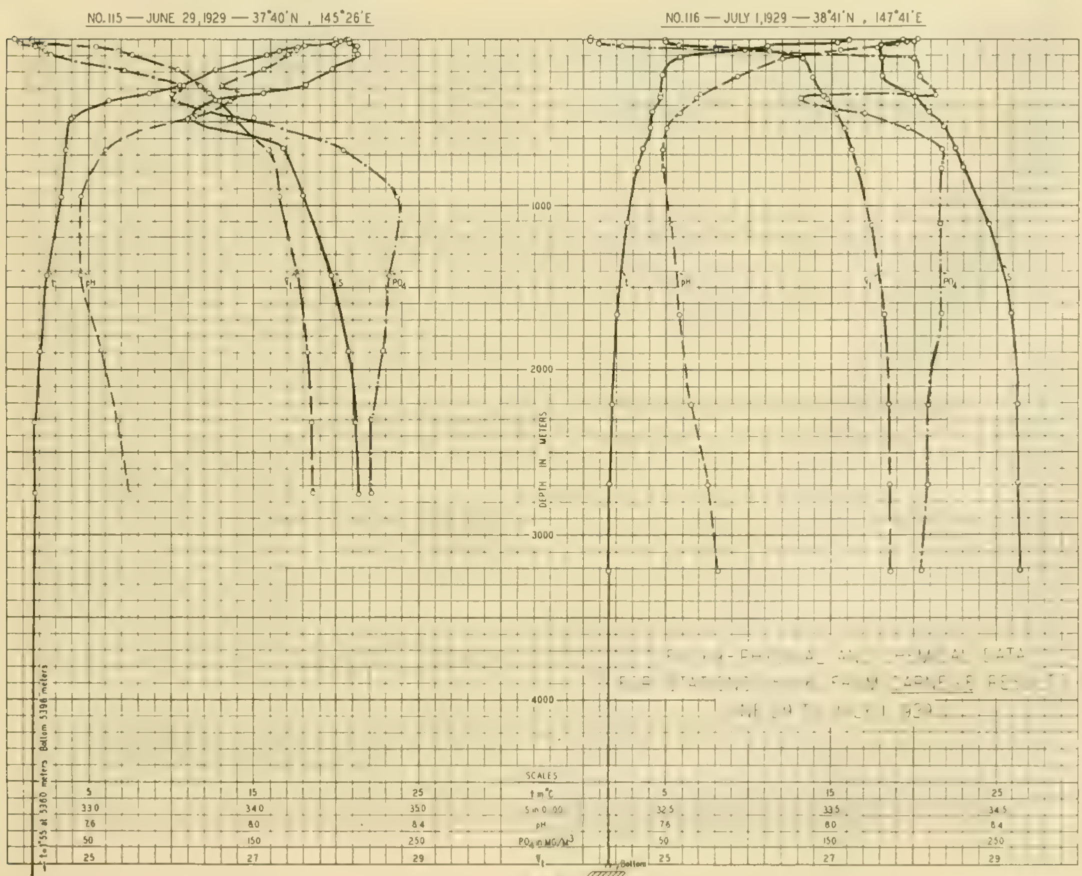


FIG. 69 – PHYSICAL AND CHEMICAL DATA FOR STATIONS 115-116 FROM CARNEGIE RESULTS JUNE 29 - JULY 1, 1929

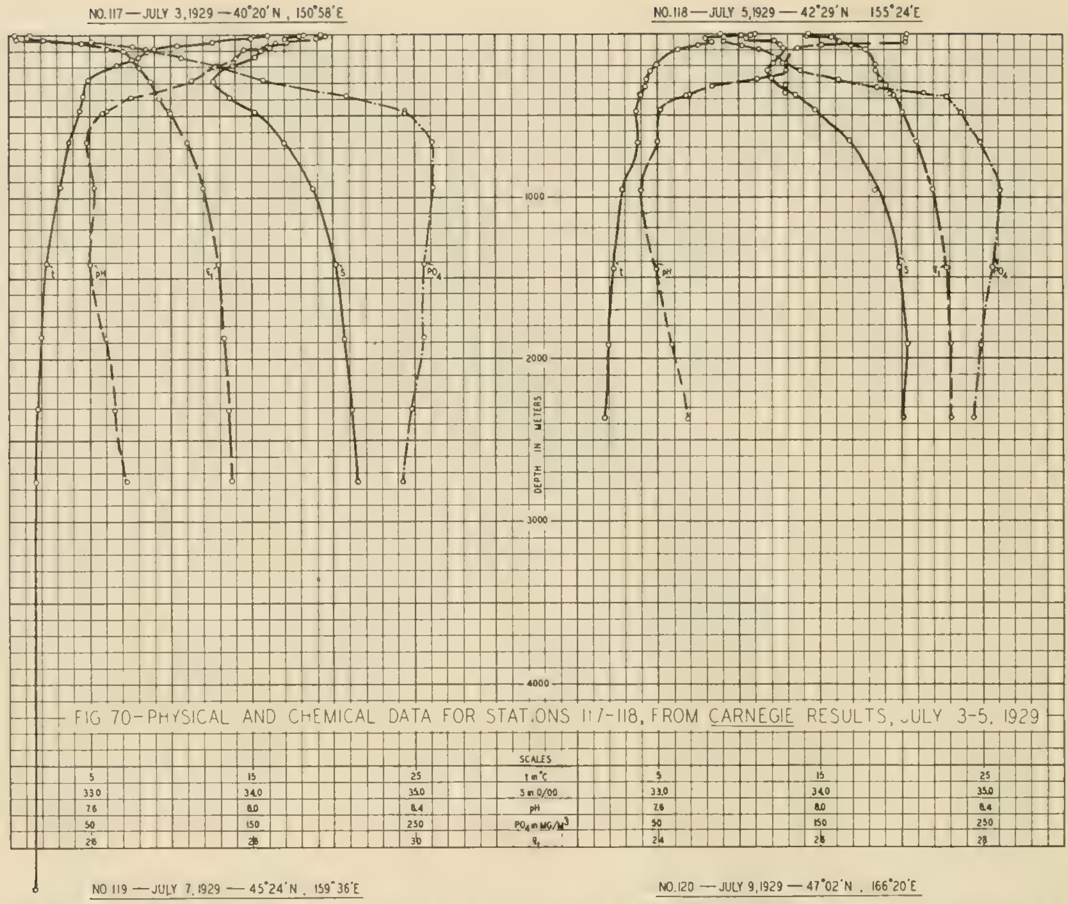


FIG 70—PHYSICAL AND CHEMICAL DATA FOR STATIONS 117-118, FROM CARNEGIE RESULTS, JULY 3-5, 1929

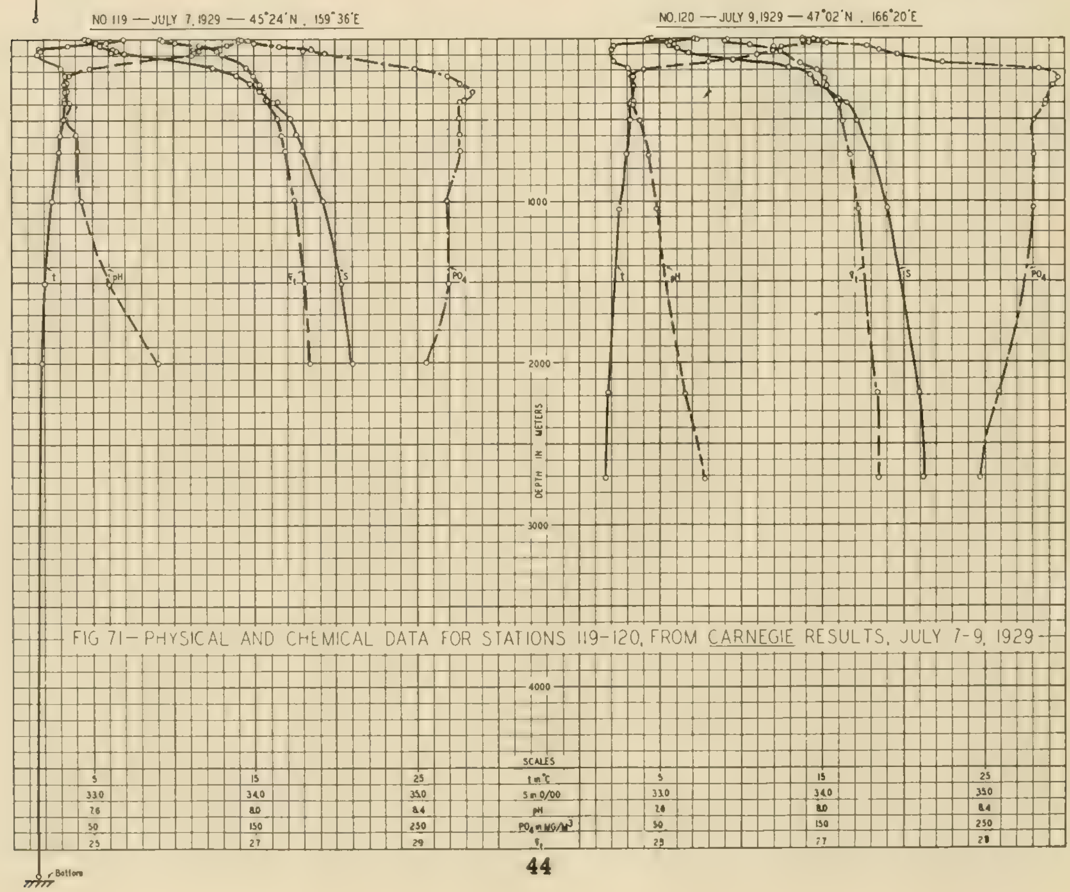


FIG 71—PHYSICAL AND CHEMICAL DATA FOR STATIONS 119-120, FROM CARNEGIE RESULTS, JULY 7-9, 1929

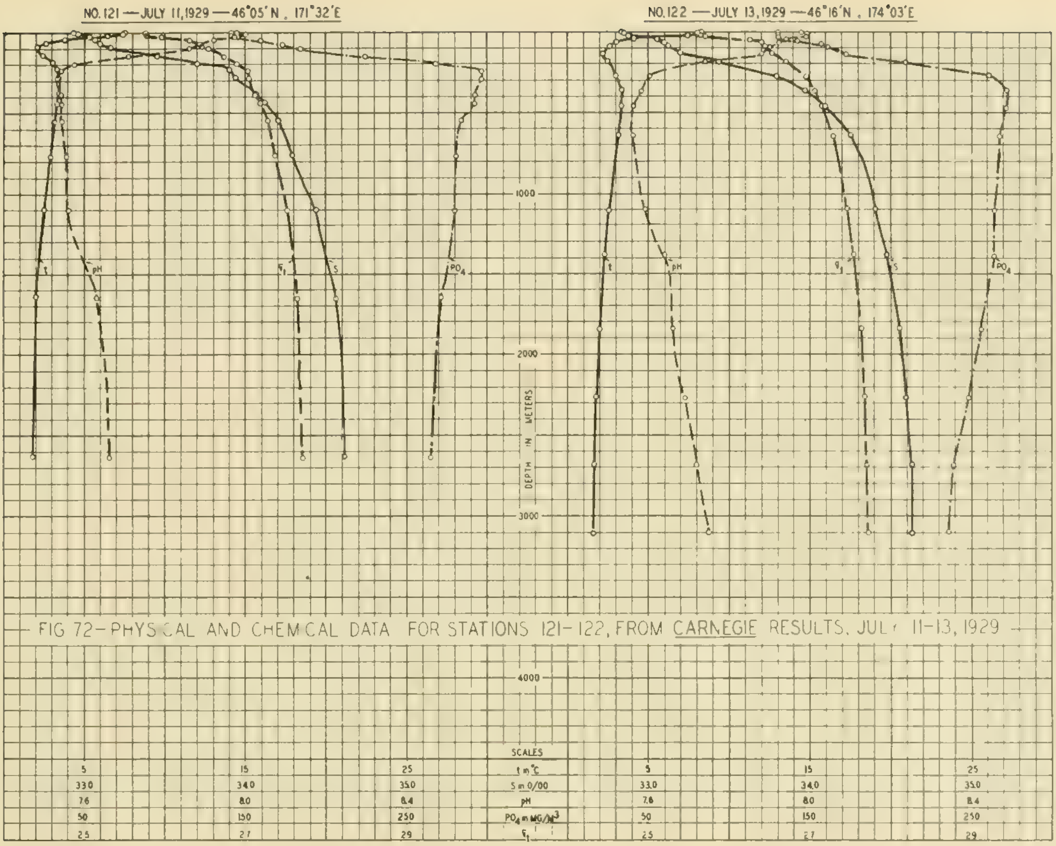


FIG 72 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 121-122, FROM CARNEGIE RESULTS, JULY 11-13, 1929

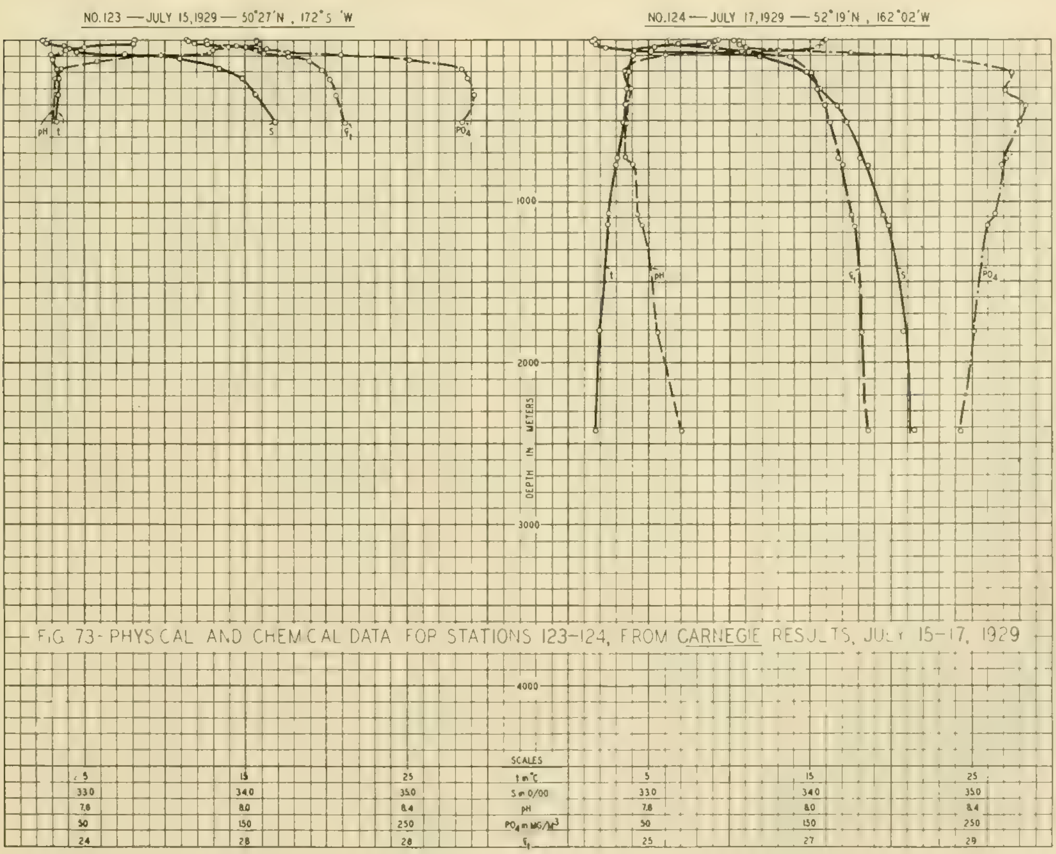


FIG 73 - PHYSICAL AND CHEMICAL DATA FOR STATIONS 123-124, FROM CARNEGIE RESULTS, JULY 15-17, 1929

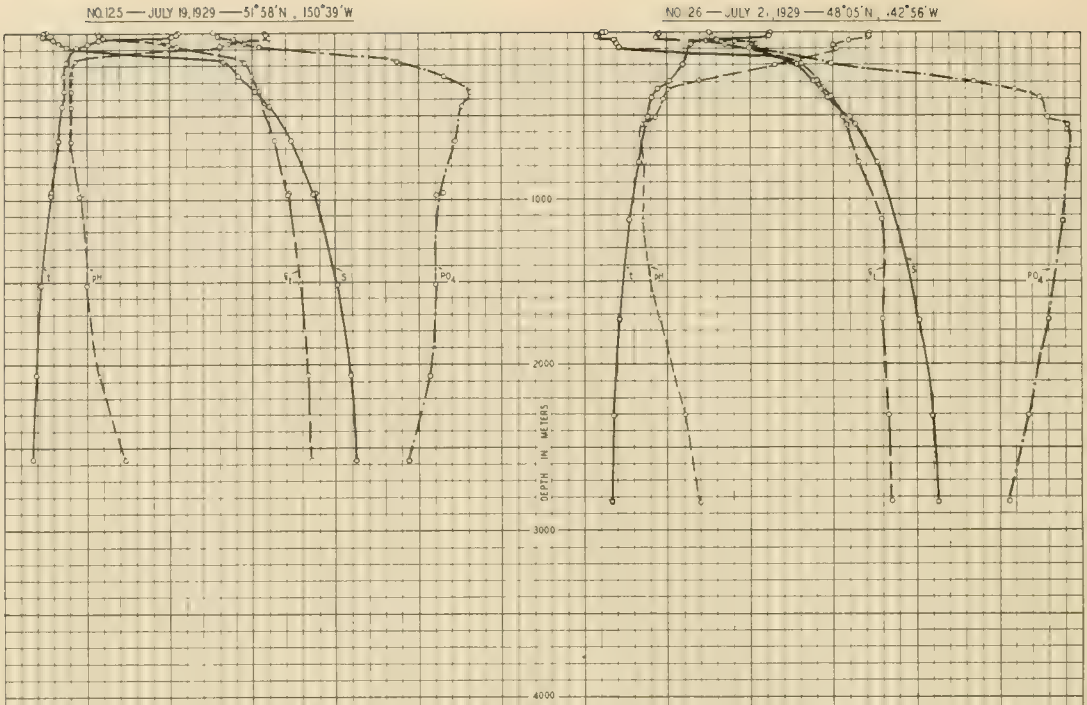


FIG 74 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 125-126, FROM CARNEGIE RESULTS, JULY 19-21, 1929

SCALES

5	15	25	t in °C	5	15	25
33.0	34.0	35.0	S in 0/00	33.0	34.0	35.0
7.6	8.0	8.4	pH	7.6	8.0	8.4
50	150	250	PO_4 in MG/M^3	50	150	250
25	27	29	σ_t	25	27	29

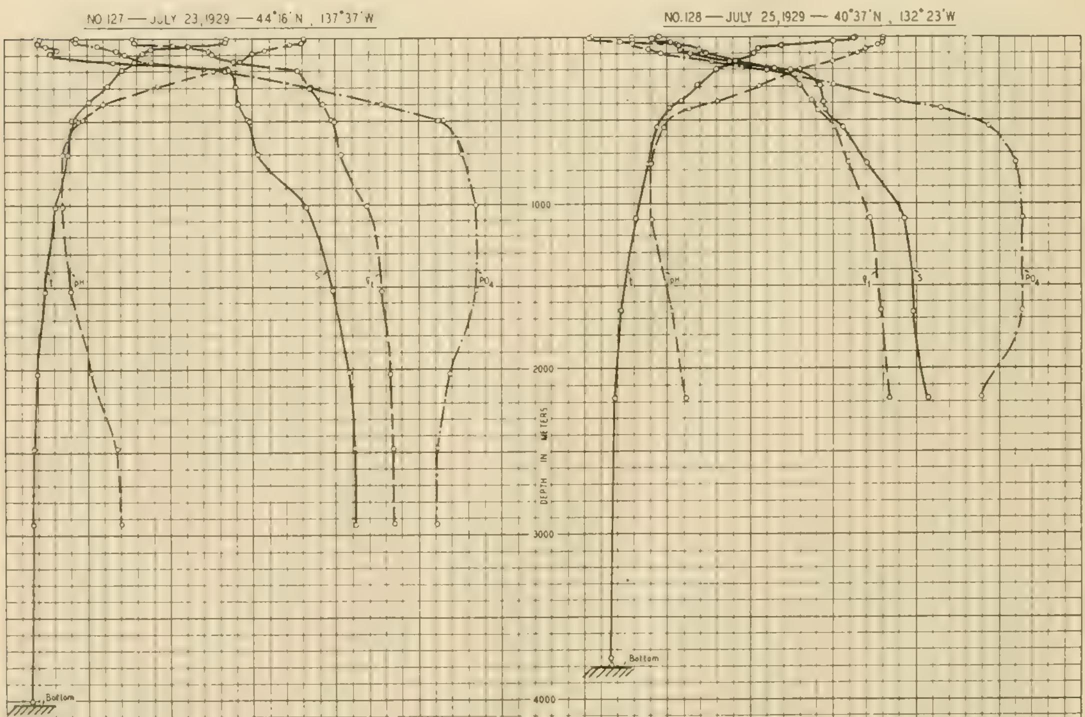


FIG 75 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 127-128, FROM CARNEGIE RESULTS, JULY 23-25, 1929

SCALES

5	15	25	t in °C	5	15	25
33.0	34.0	35.0	S in 0/00	33.0	34.0	35.0
7.6	8.0	8.4	pH	7.6	8.0	8.4
50	150	250	PO_4 in MG/M^3	50	150	250
24	26	28	σ_t	25	27	29

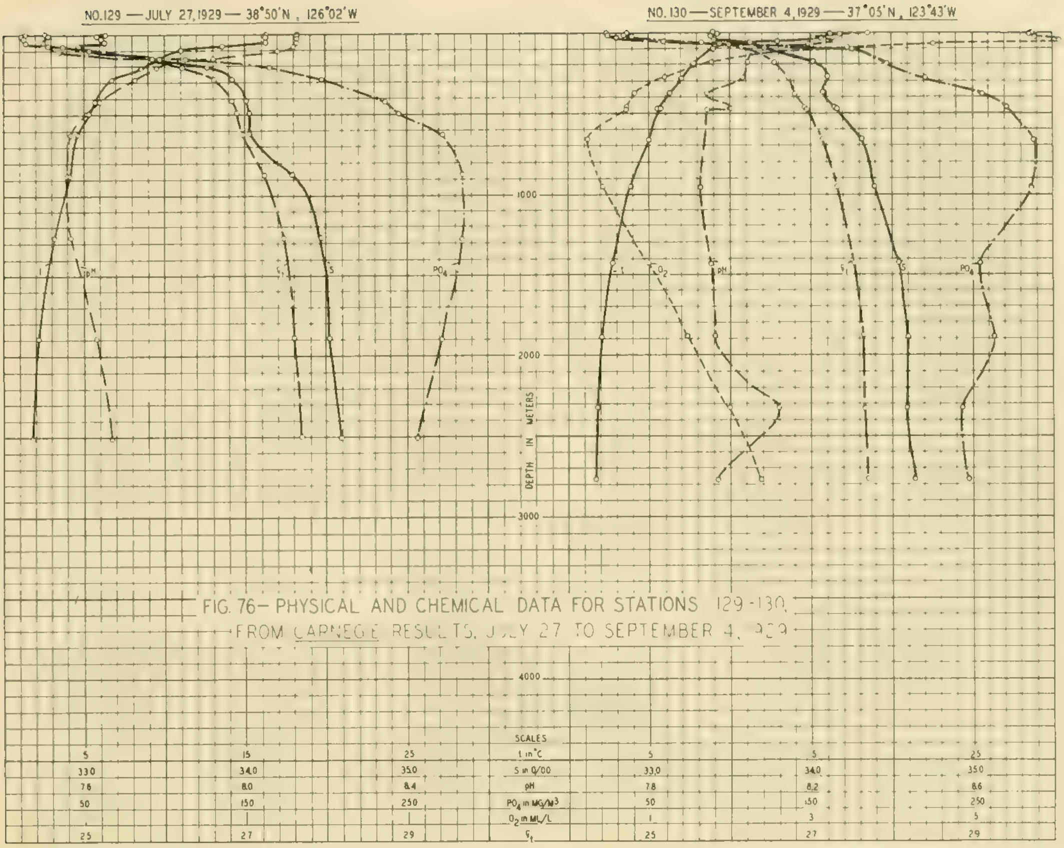


FIG. 76— PHYSICAL AND CHEMICAL DATA FOR STATIONS 129-130, FROM CARNEGIE RESULTS, JULY 27 TO SEPTEMBER 4, 1929

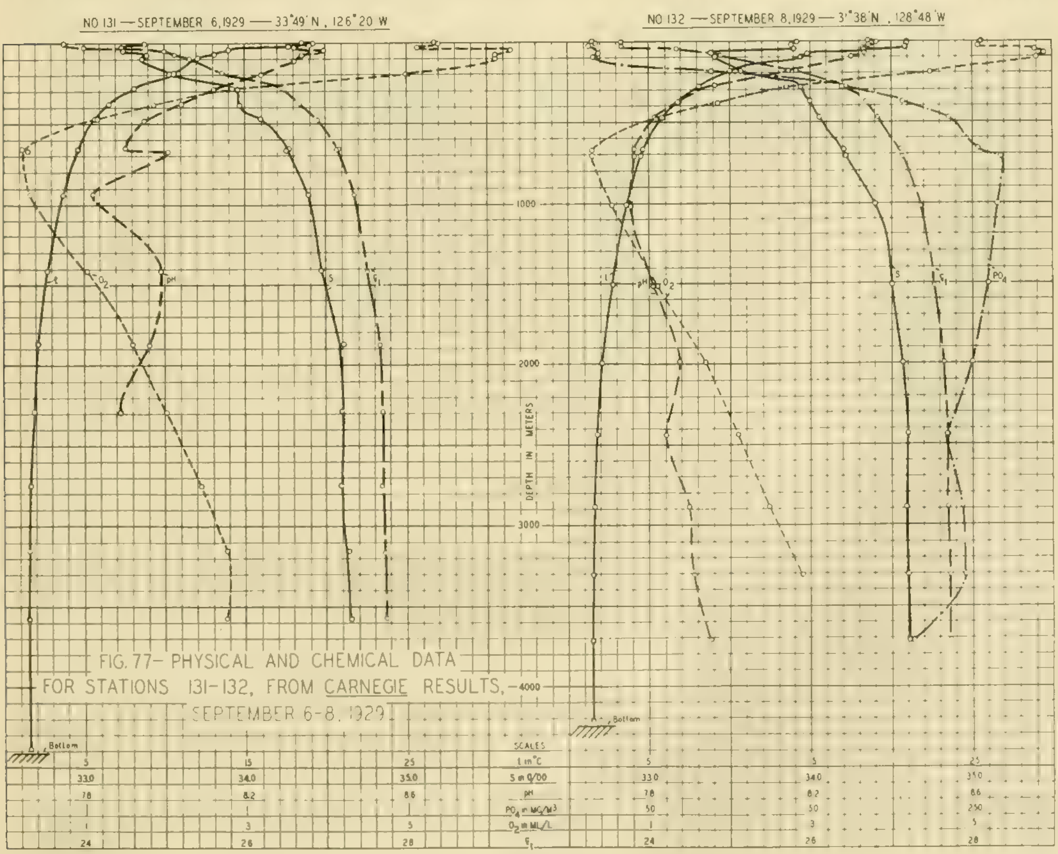


FIG. 77— PHYSICAL AND CHEMICAL DATA FOR STATIONS 131-132, FROM CARNEGIE RESULTS, SEPTEMBER 6-8, 1929

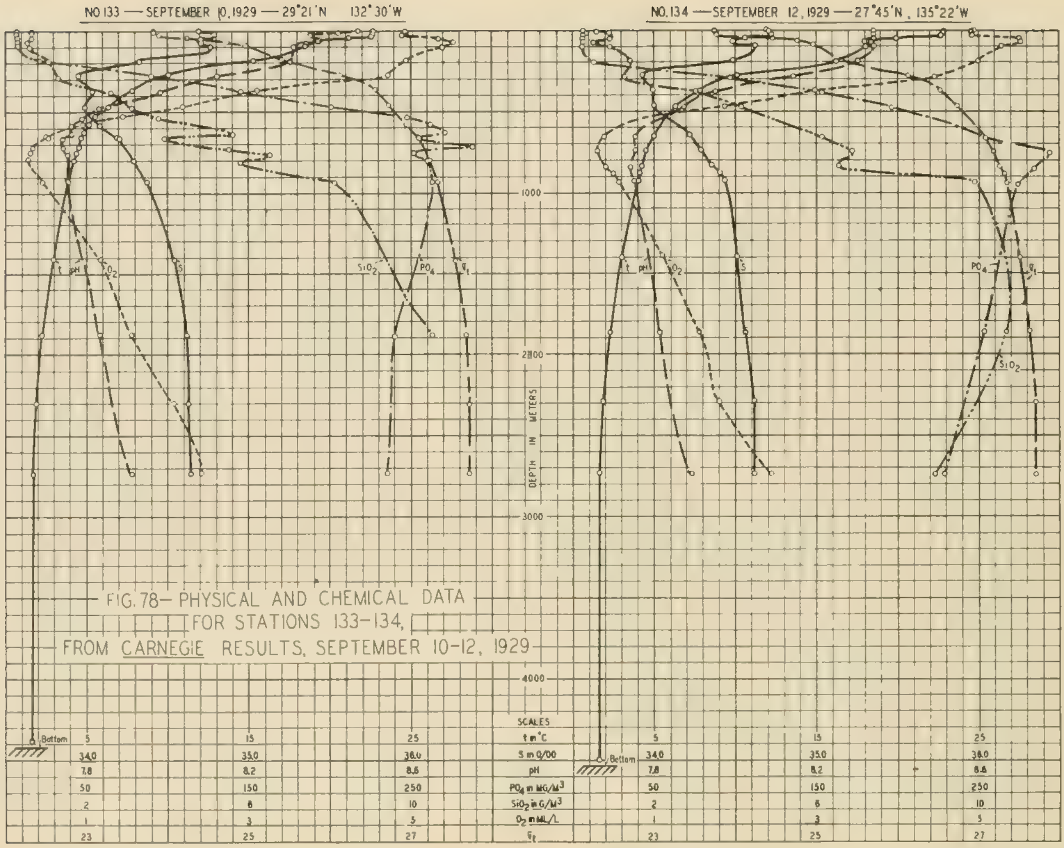


FIG. 78—PHYSICAL AND CHEMICAL DATA FOR STATIONS 133–134, FROM CARNEGIE RESULTS, SEPTEMBER 10–12, 1929

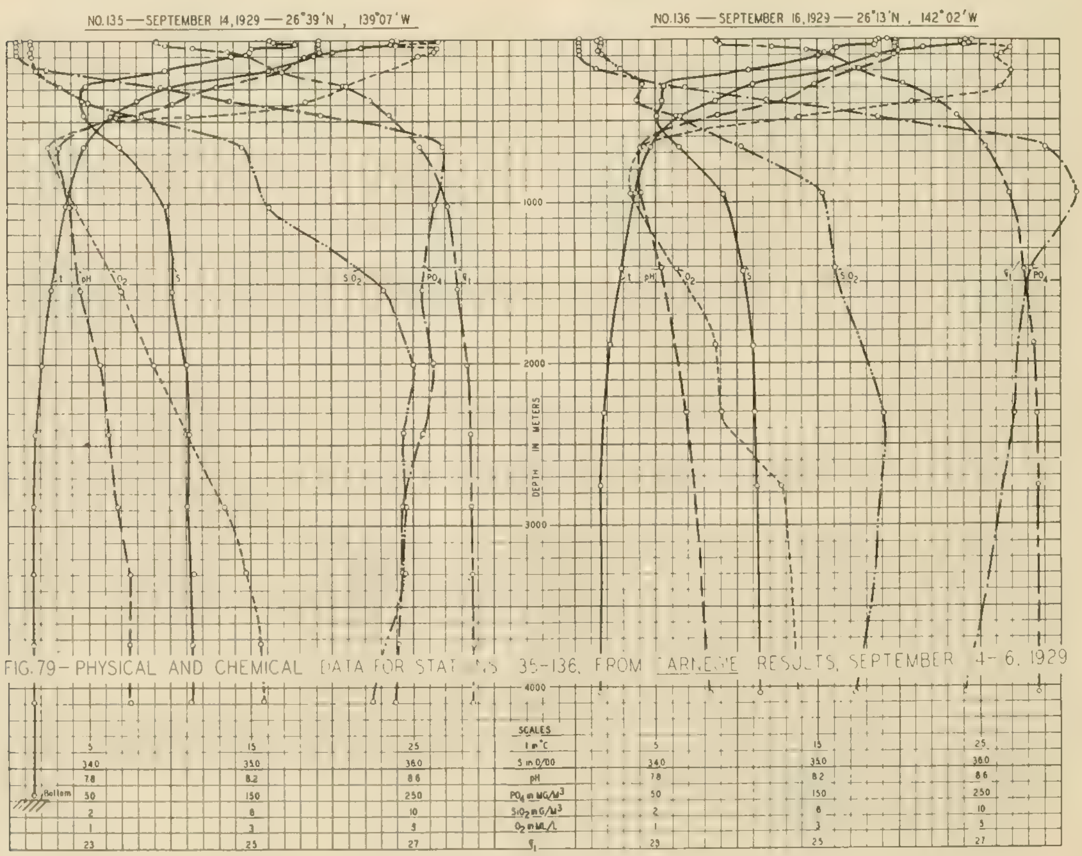


FIG. 79—PHYSICAL AND CHEMICAL DATA FOR STATIONS 135–136, FROM CARNEGIE RESULTS, SEPTEMBER 14–16, 1929

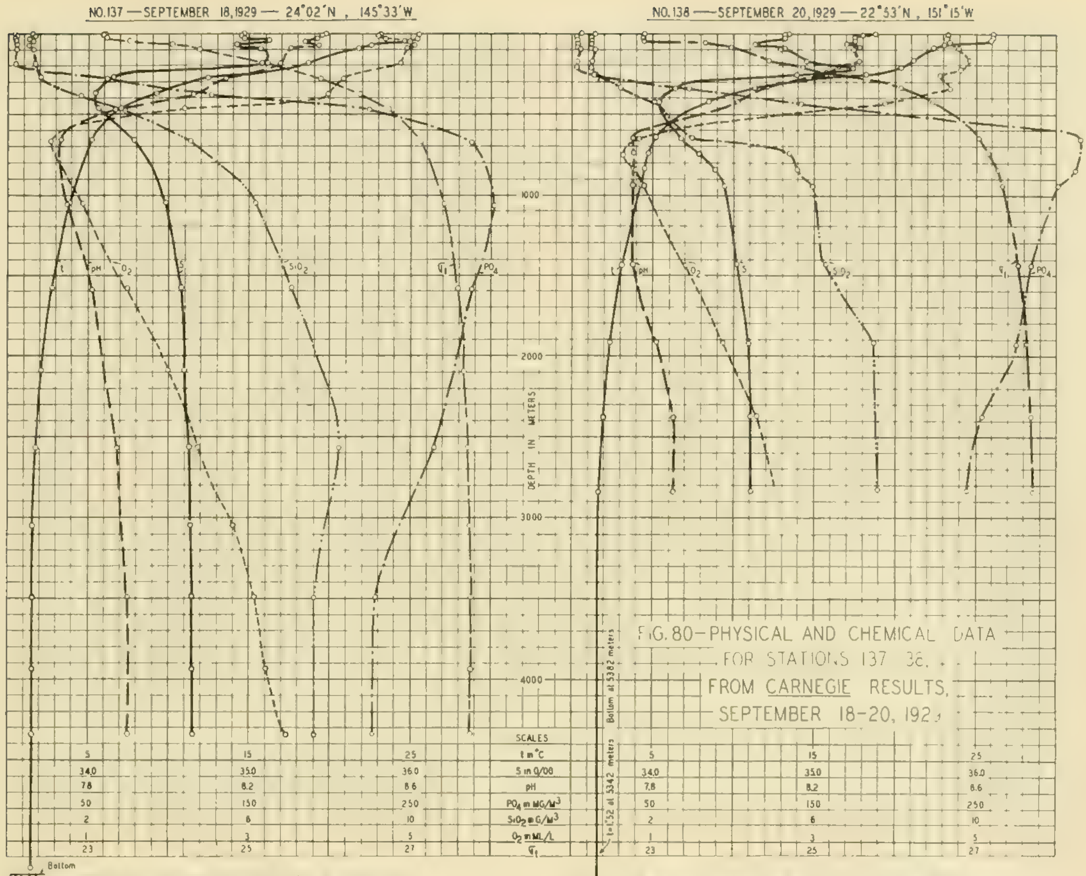


FIG. 80 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 137–138, FROM CARNEGIE RESULTS, SEPTEMBER 18–20, 1929

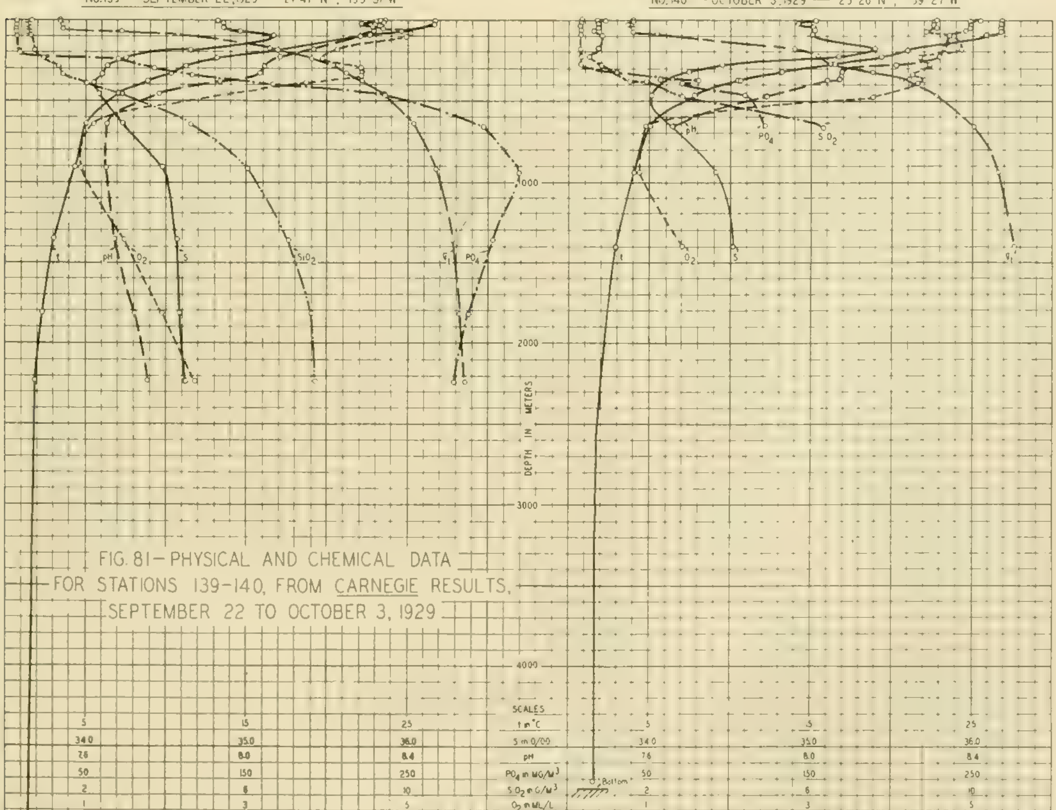


FIG. 81 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 139–140, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 3, 1929

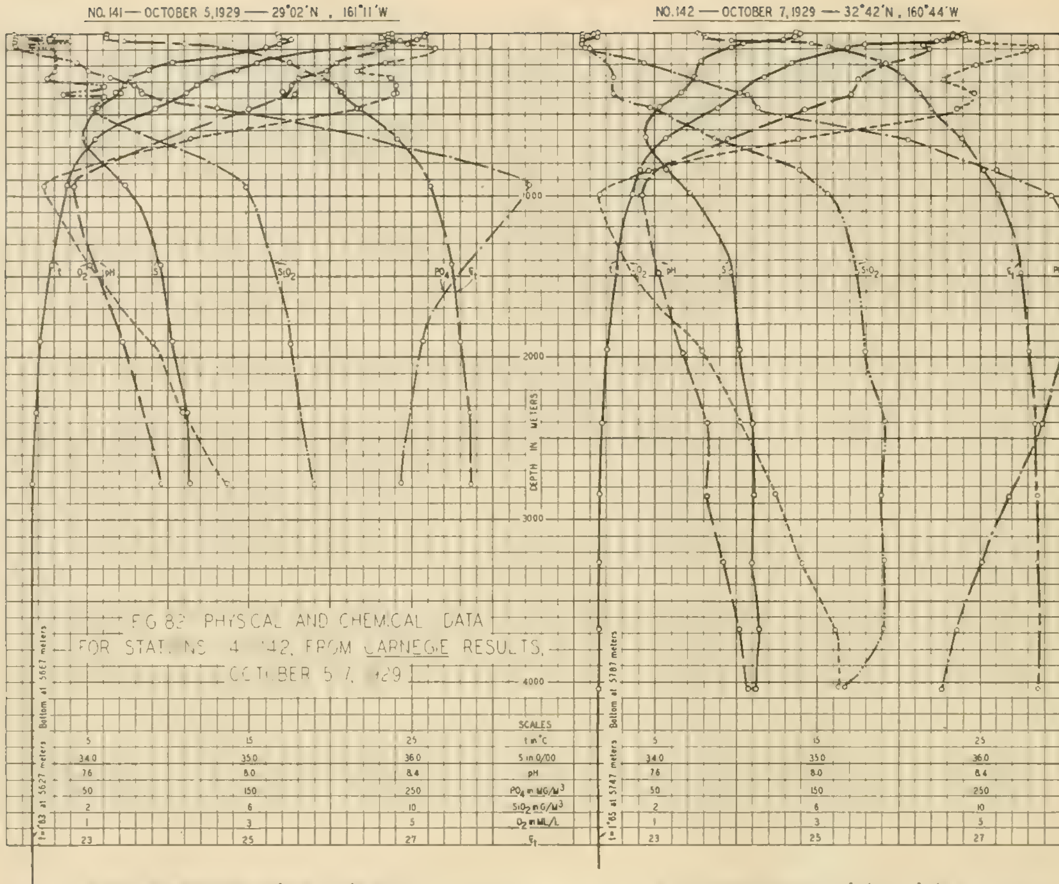


FIG. 82—PHYSICAL AND CHEMICAL DATA FOR STATIONS 141-142, FROM CARNEGIE RESULTS, OCTOBER 5-7, 1929

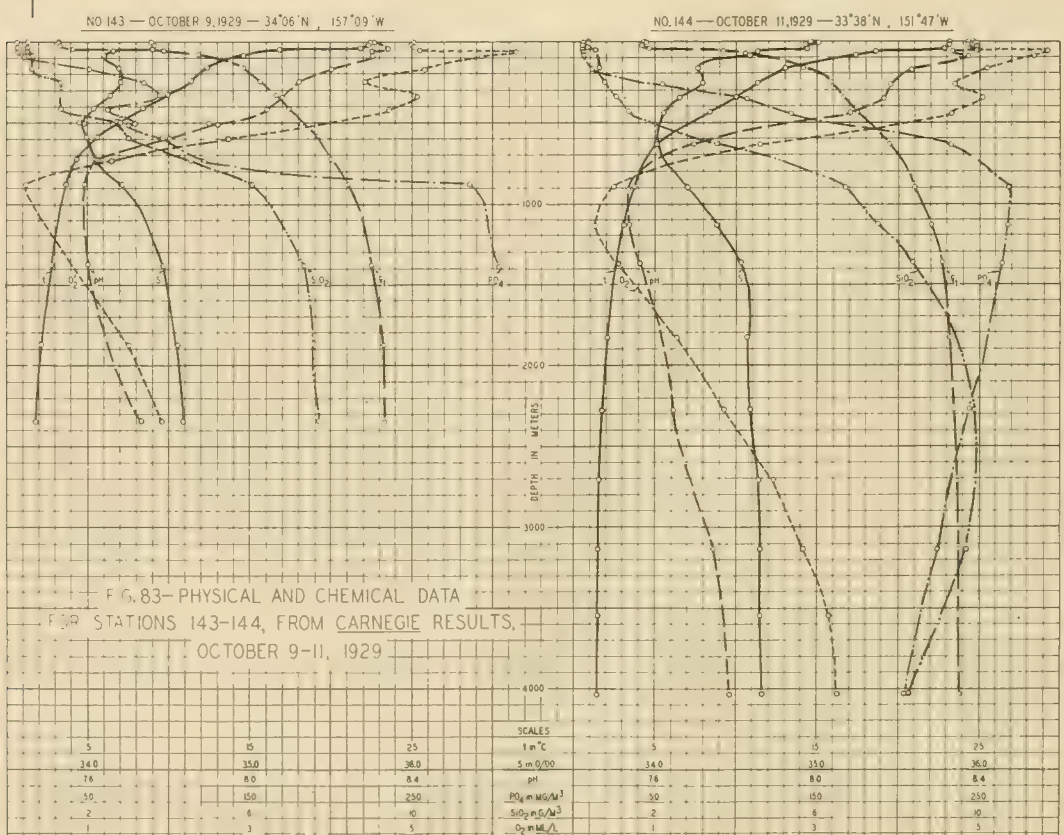


FIG. 83—PHYSICAL AND CHEMICAL DATA FOR STATIONS 143-144, FROM CARNEGIE RESULTS, OCTOBER 9-11, 1929

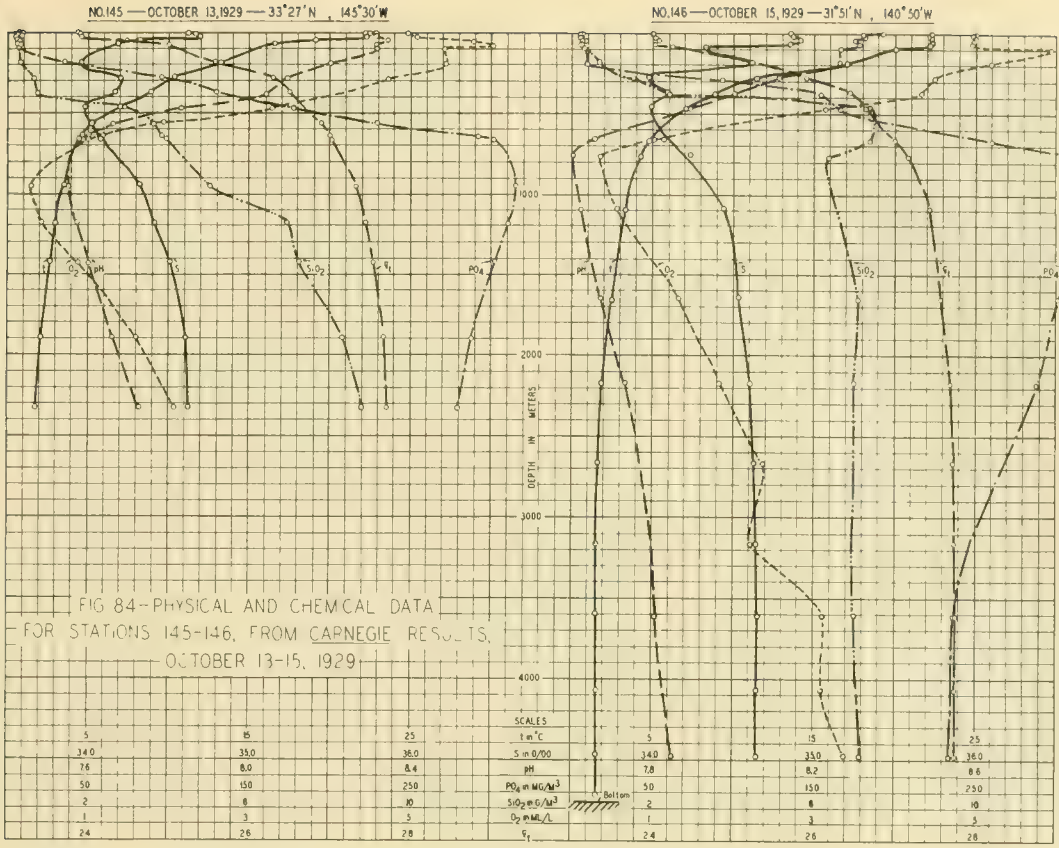


FIG 84—PHYSICAL AND CHEMICAL DATA FOR STATIONS 145-146, FROM CARNEGIE RESULTS, OCTOBER 13-15, 1929

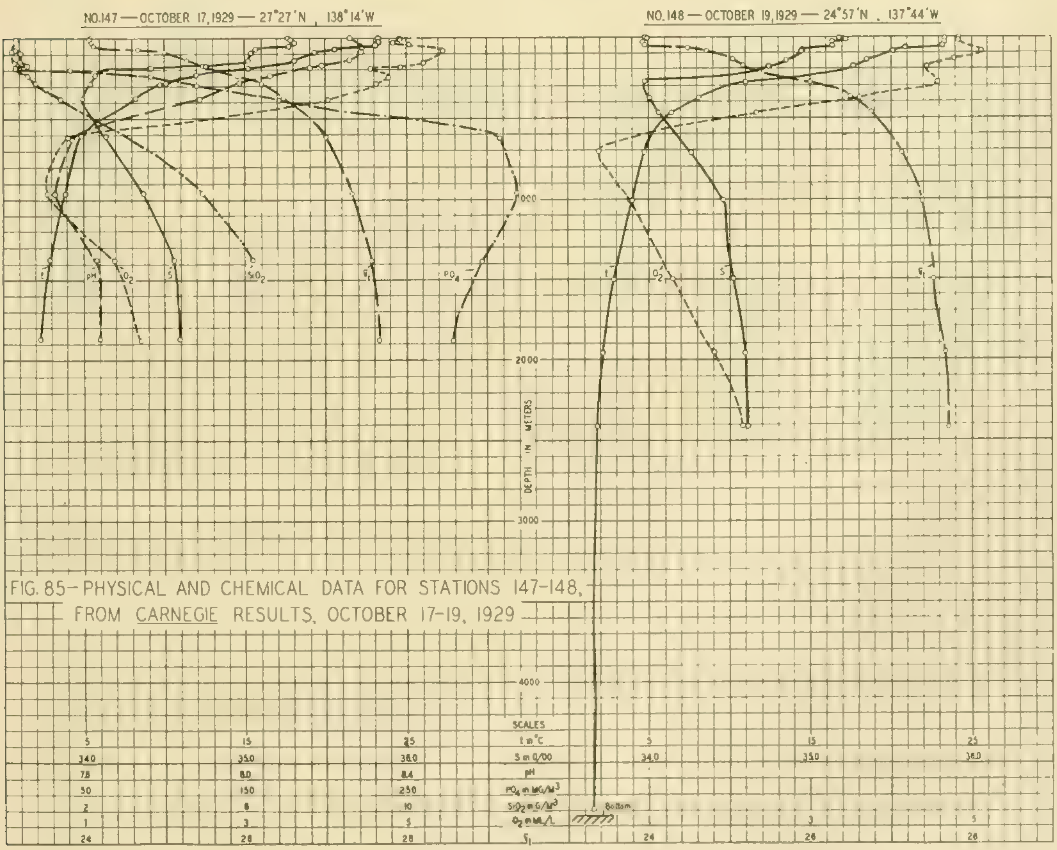


FIG. 85—PHYSICAL AND CHEMICAL DATA FOR STATIONS 147-148, FROM CARNEGIE RESULTS, OCTOBER 17-19, 1929

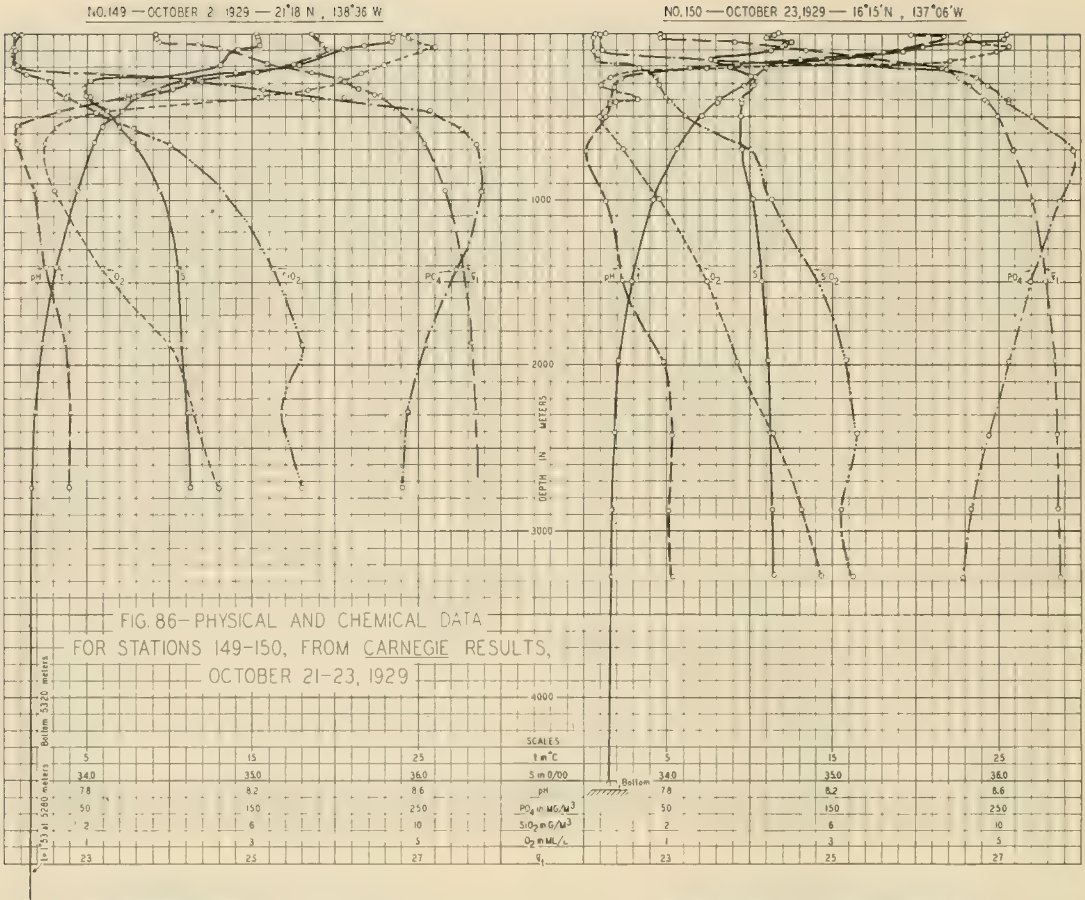


FIG. 86—PHYSICAL AND CHEMICAL DATA FOR STATIONS 149–150, FROM CARNEGIE RESULTS, OCTOBER 21–23, 1929

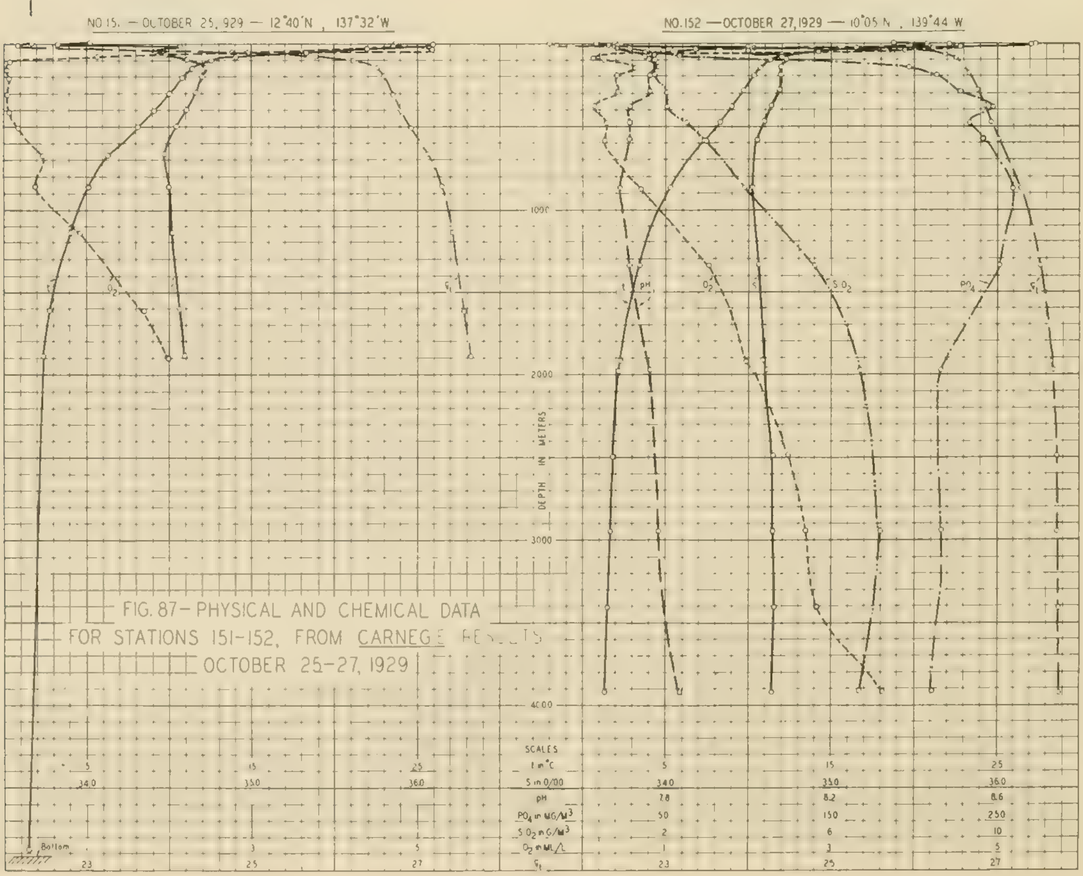


FIG. 87—PHYSICAL AND CHEMICAL DATA FOR STATIONS 151–152, FROM CARNEGIE RESULTS, OCTOBER 25–27, 1929

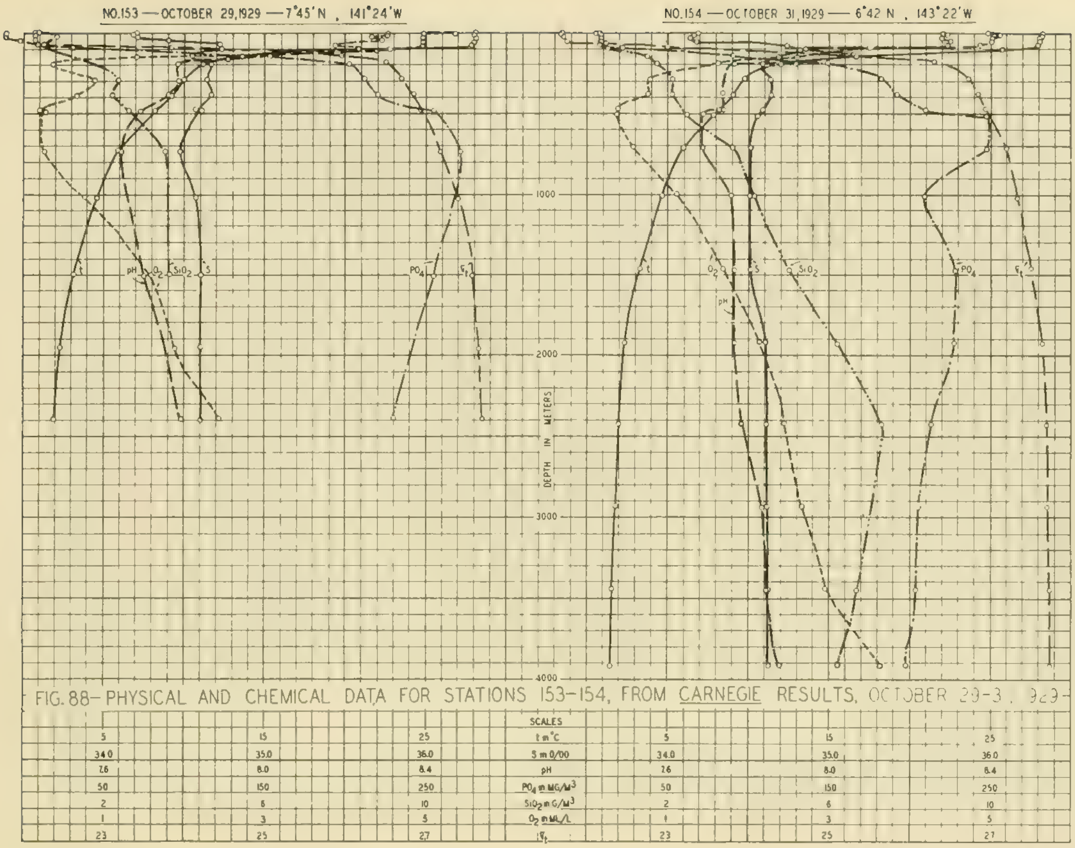


FIG. 88–PHYSICAL AND CHEMICAL DATA FOR STATIONS 153–154, FROM CARNEGIE RESULTS, OCTOBER 29–31, 1929

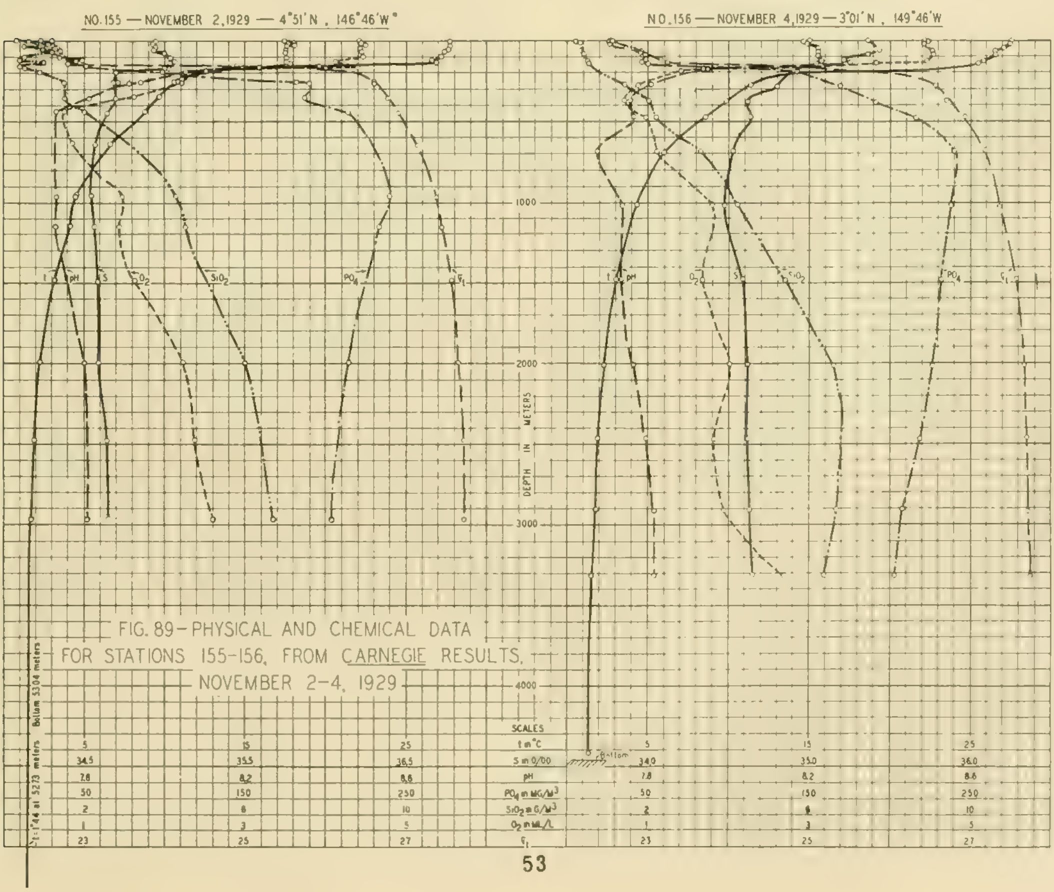


FIG. 89–PHYSICAL AND CHEMICAL DATA FOR STATIONS 155–156, FROM CARNEGIE RESULTS, NOVEMBER 2–4, 1929

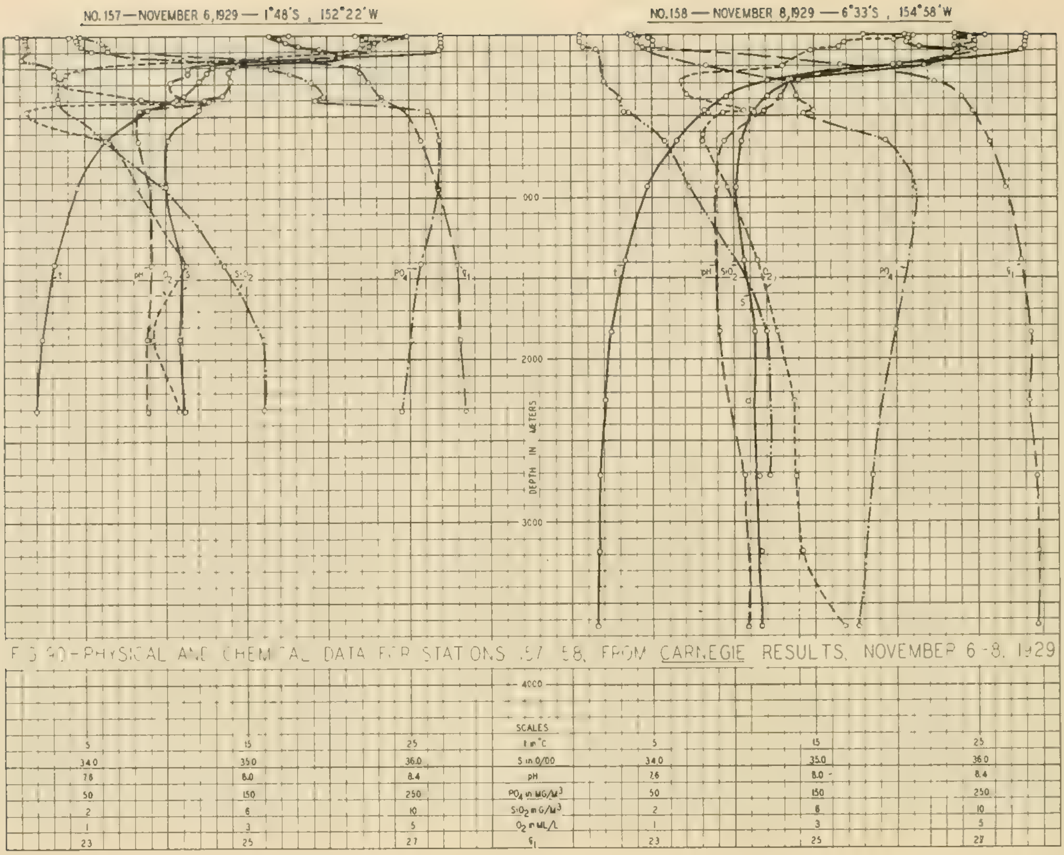


FIG. 90 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 157–158, FROM CARNEGIE RESULTS, NOVEMBER 6–8, 1929

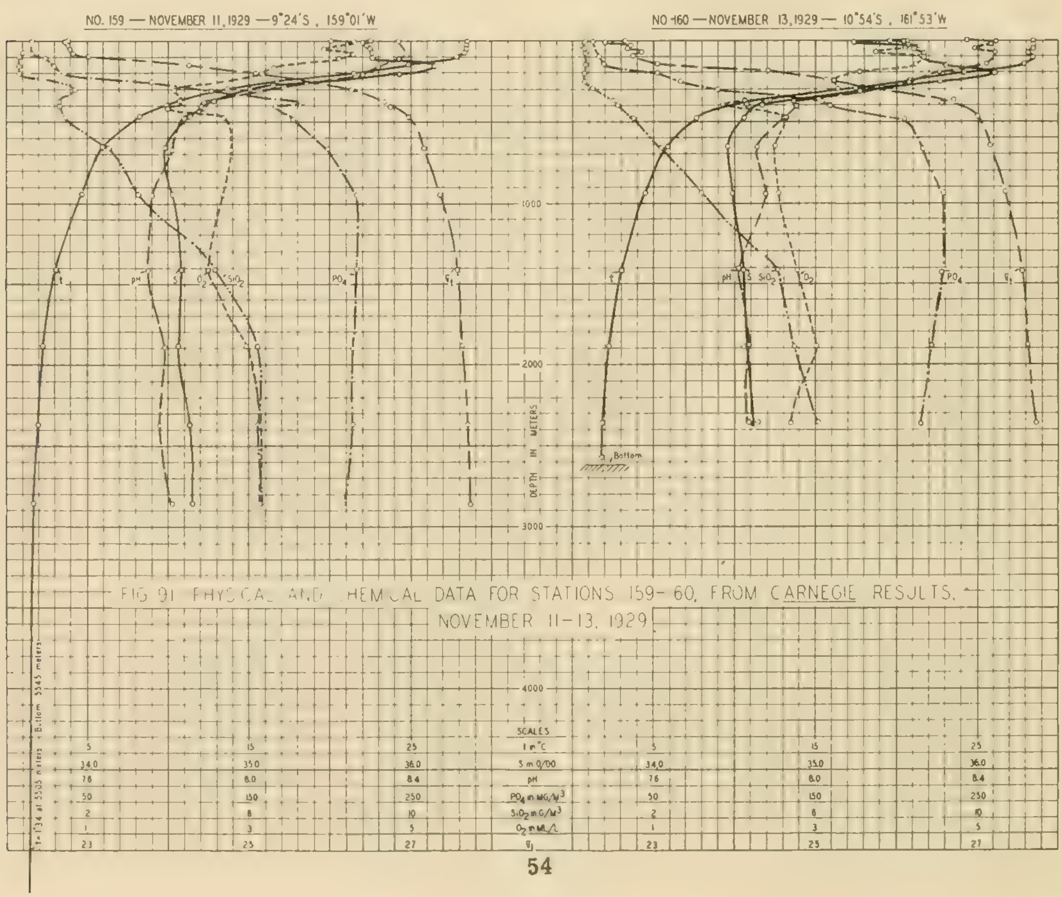


FIG. 91 — PHYSICAL AND CHEMICAL DATA FOR STATIONS 159–160, FROM CARNEGIE RESULTS, NOVEMBER 11–13, 1929

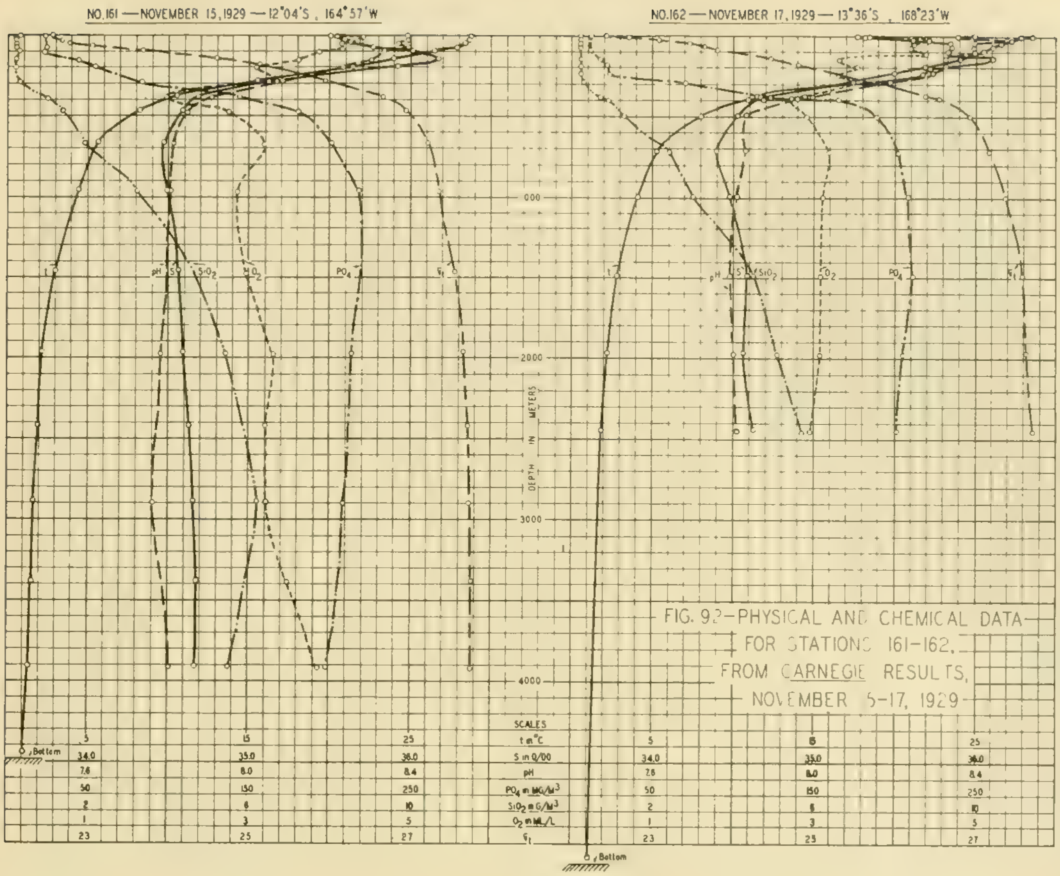


FIG. 92—PHYSICAL AND CHEMICAL DATA FOR STATIONS 161–162, FROM *CARNEGIE* RESULTS, NOVEMBER 15–17, 1929

FIG. 93—VERTICAL DISTRIBUTION SOUNDING VELOCITY ATLANTIC OCEAN, FROM CARNEGIE RESULTS, AUGUST 7-31, 1928

FIG. 94—VERTICAL DISTRIBUTION TEMPERATURE, ATLANTIC OCEAN, FROM CARNEGIE RESULTS, AUGUST 7-31, 1928

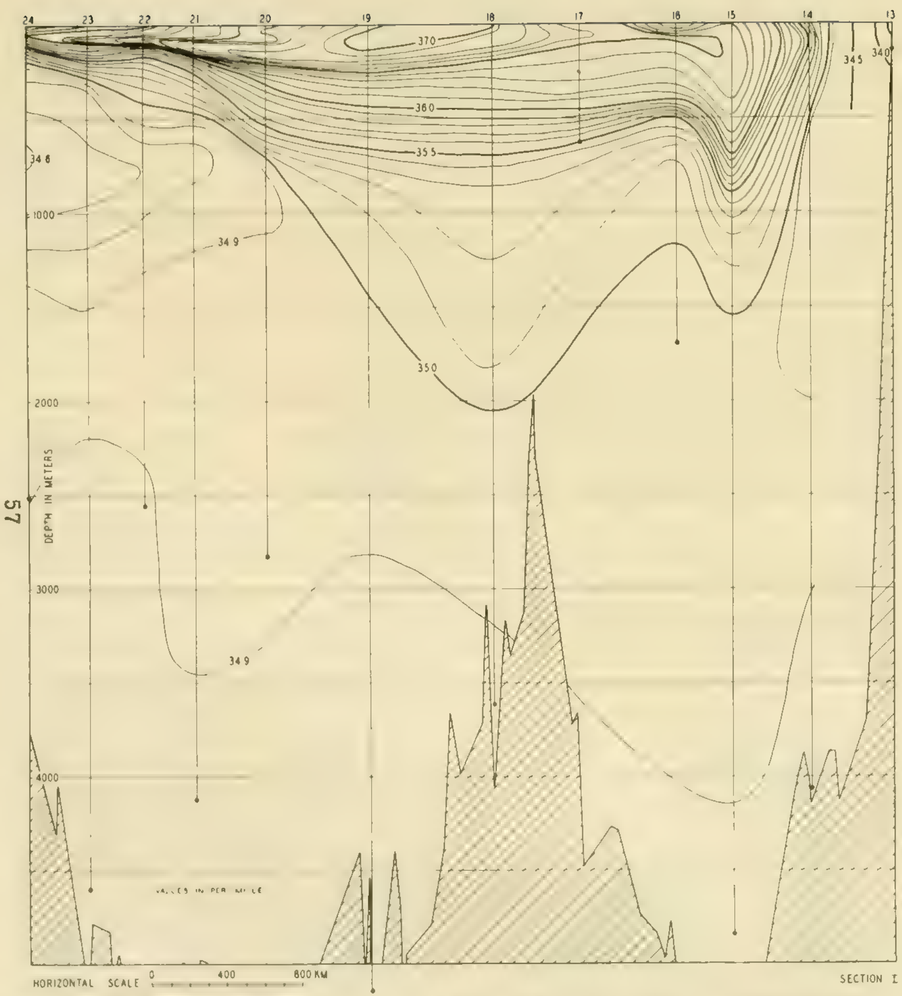


FIG. 95—VERTICAL DISTRIBUTION OF SALINITY, ATLANTIC OCEAN FROM CARNEGIE RESULTS, AUGUST 7-31, 1928

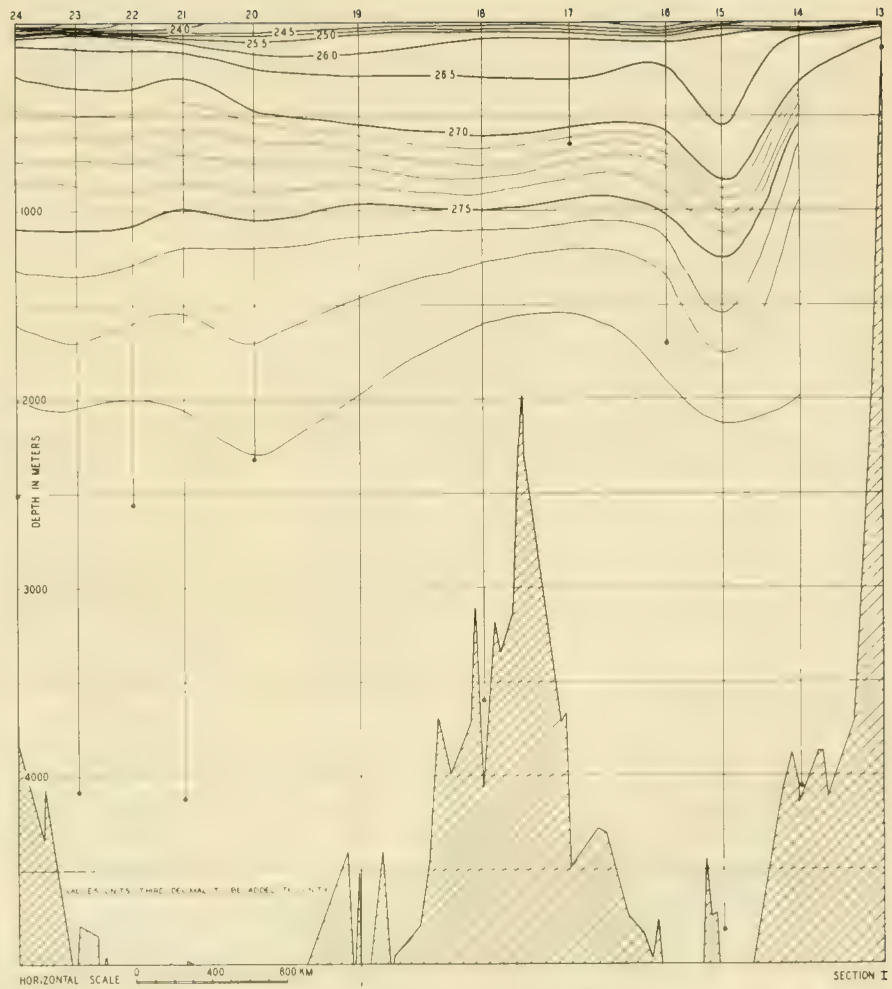


FIG. 96—VERTICAL DISTRIBUTION OF DENSITY, ATLANTIC OCEAN FROM CARNEGIE RESULTS, AUGUST 7-31, 1928

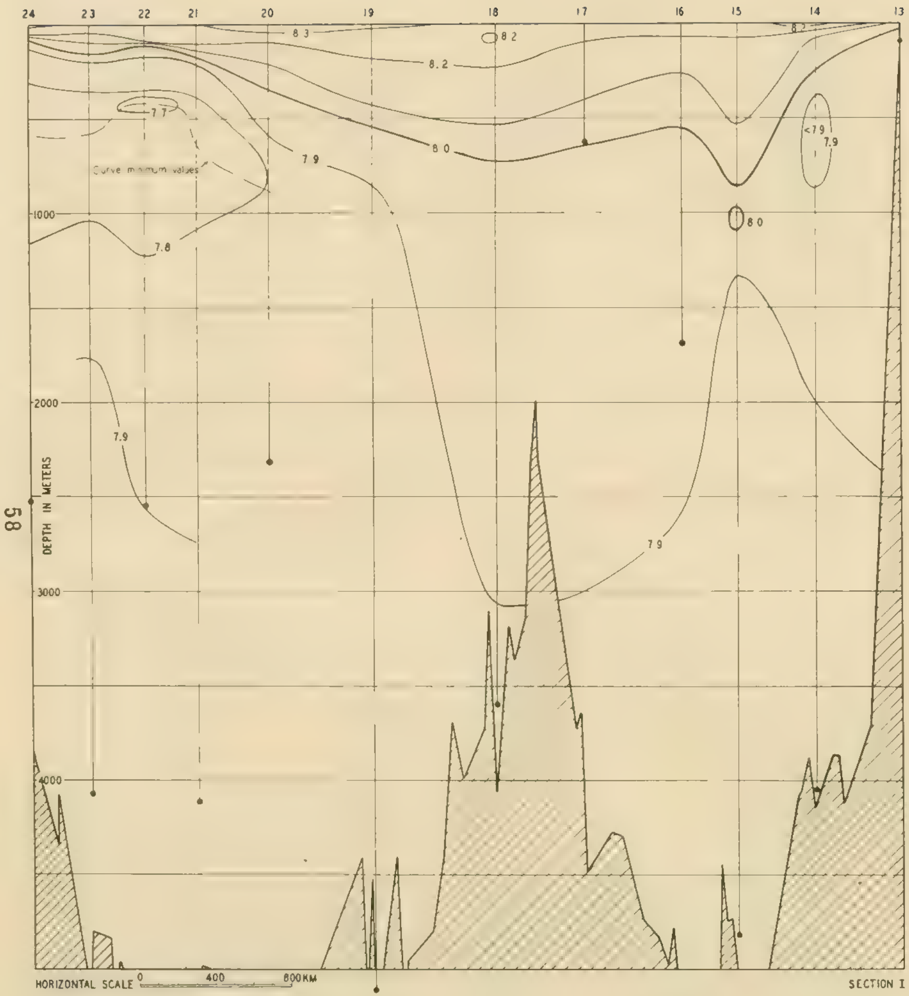


FIG. 97—VERTICAL DISTRIBUTION HYDROGEN ION, ATLANTIC OCEAN, FROM CARNEGIE RESULTS, AUGUST 7-31 1928

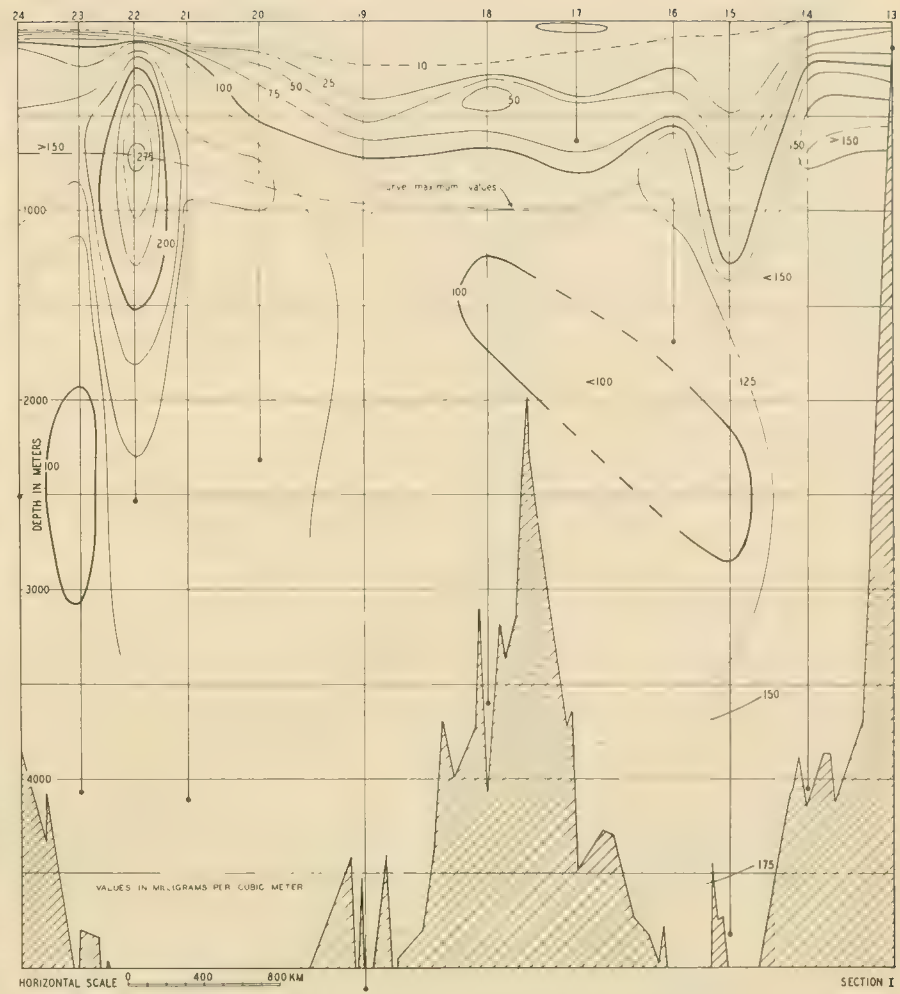


FIG. 98—VERTICAL DISTRIBUTION PHOSPHATE, ATLANTIC OCEAN, FROM CARNEGIE RESULTS, AUGUST 7-31, 1928

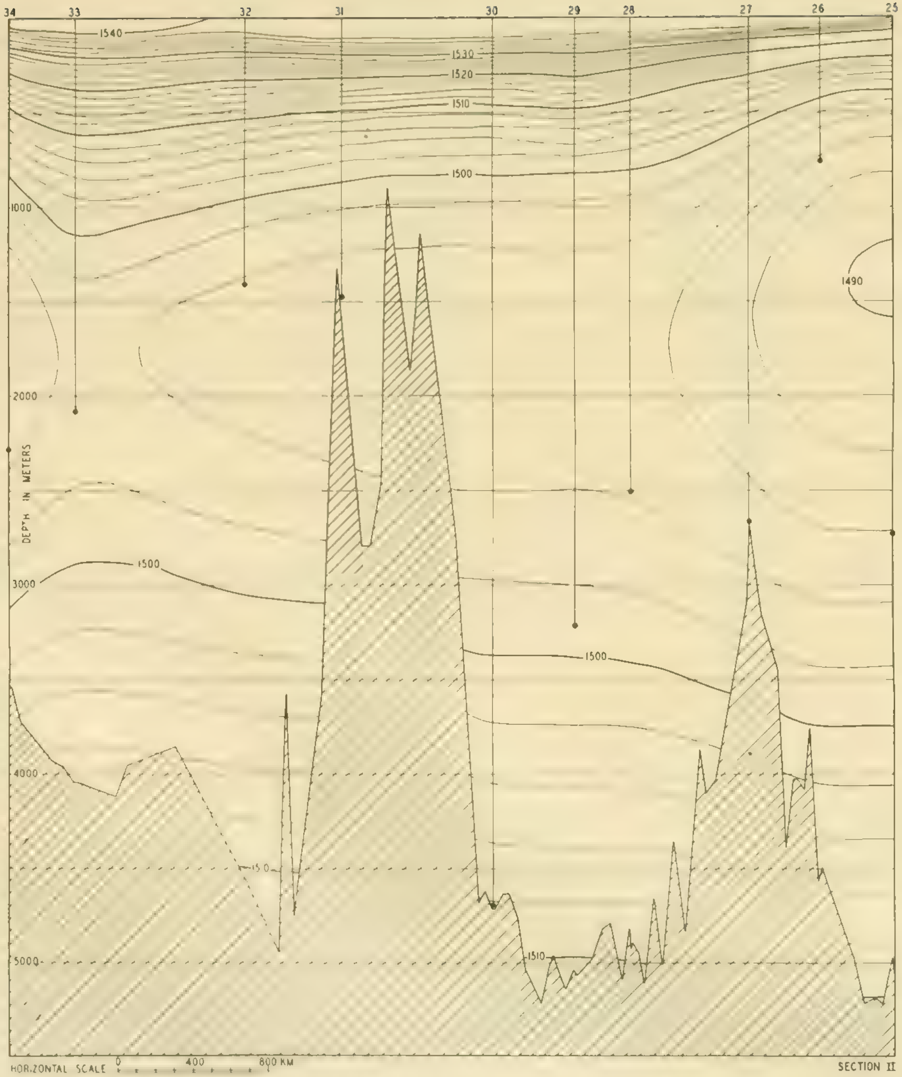


FIG 99—VERTICAL DISTRIBUTION SOUNDING VELOCITY, ATLANTIC OCEAN, FROM *CARNEGIE* RESULTS, SEPTEMBER 3 TO OCTOBER 9, 1928

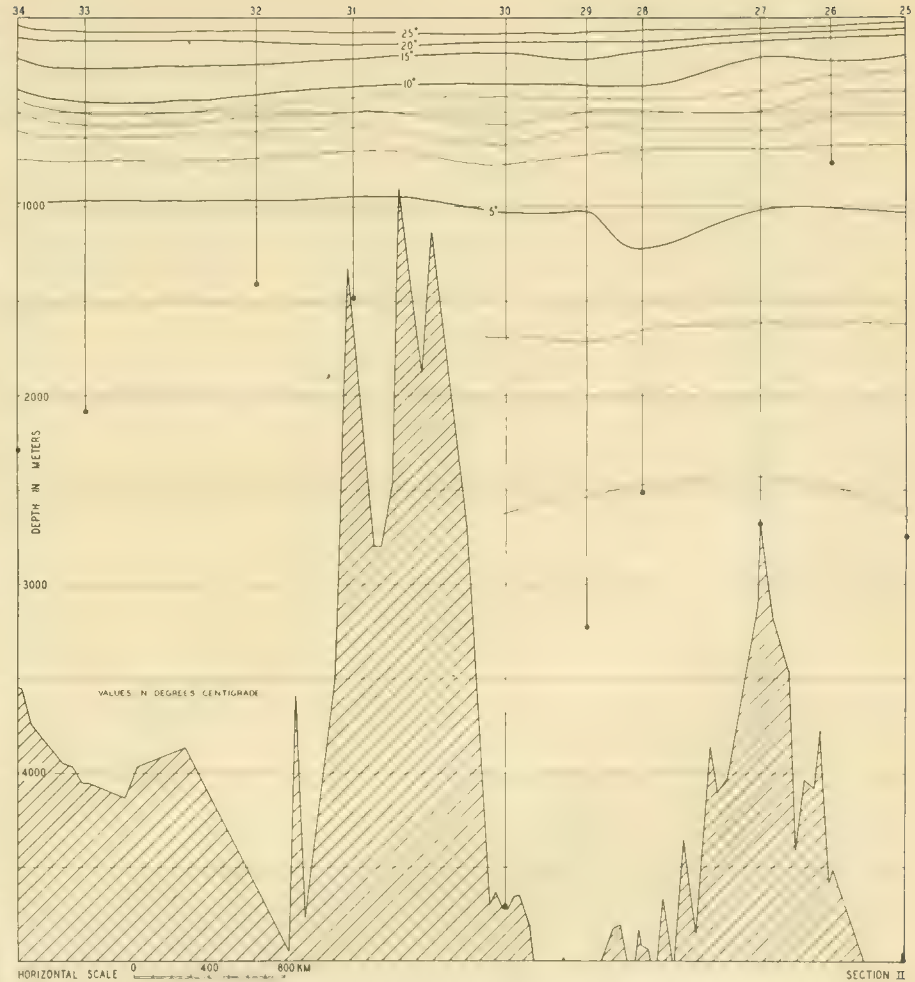


FIG 100—VERTICAL DISTRIBUTION TEMPERATURE, ATLANTIC OCEAN, FROM *CARNEGIE* RESULTS, SEPTEMBER 3, TO OCTOBER 9, 1928

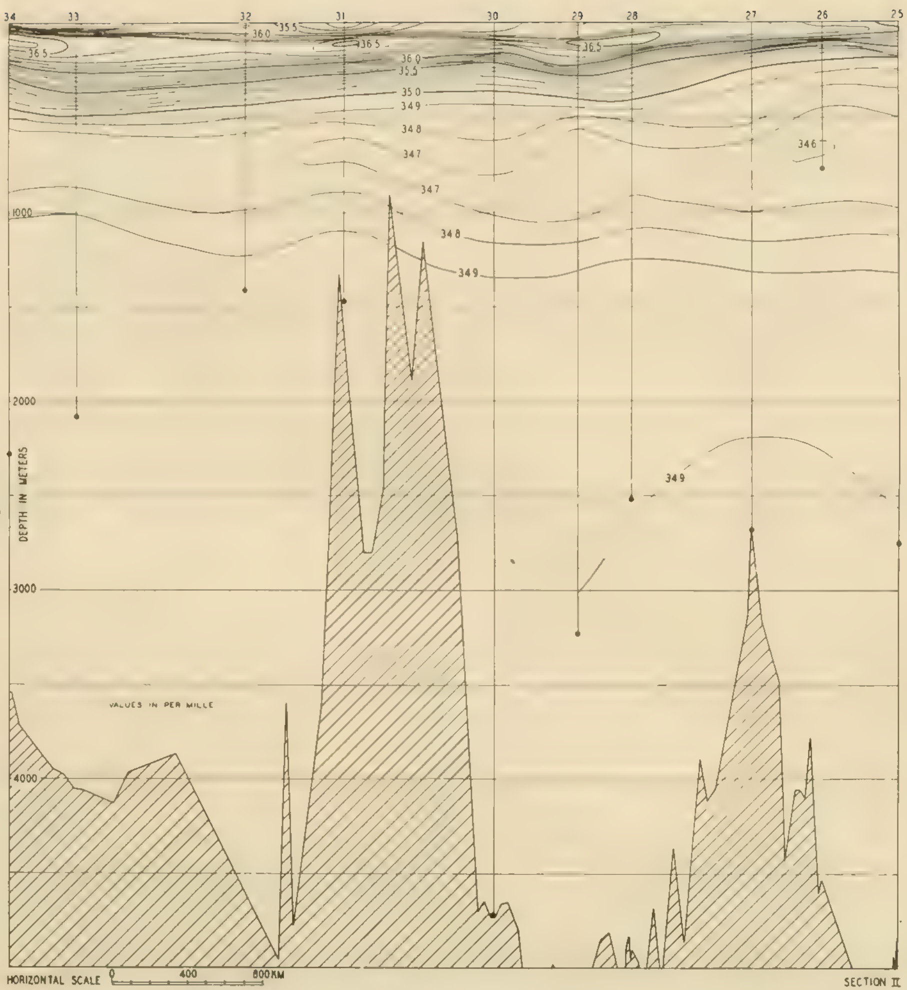


FIG 101—VERTICAL DISTRIBUTION SALINITY, ATLANTIC OCEAN, FROM *CARNEGIE* RESULTS, SEPTEMBER 3 TO OCTOBER 9, 1928

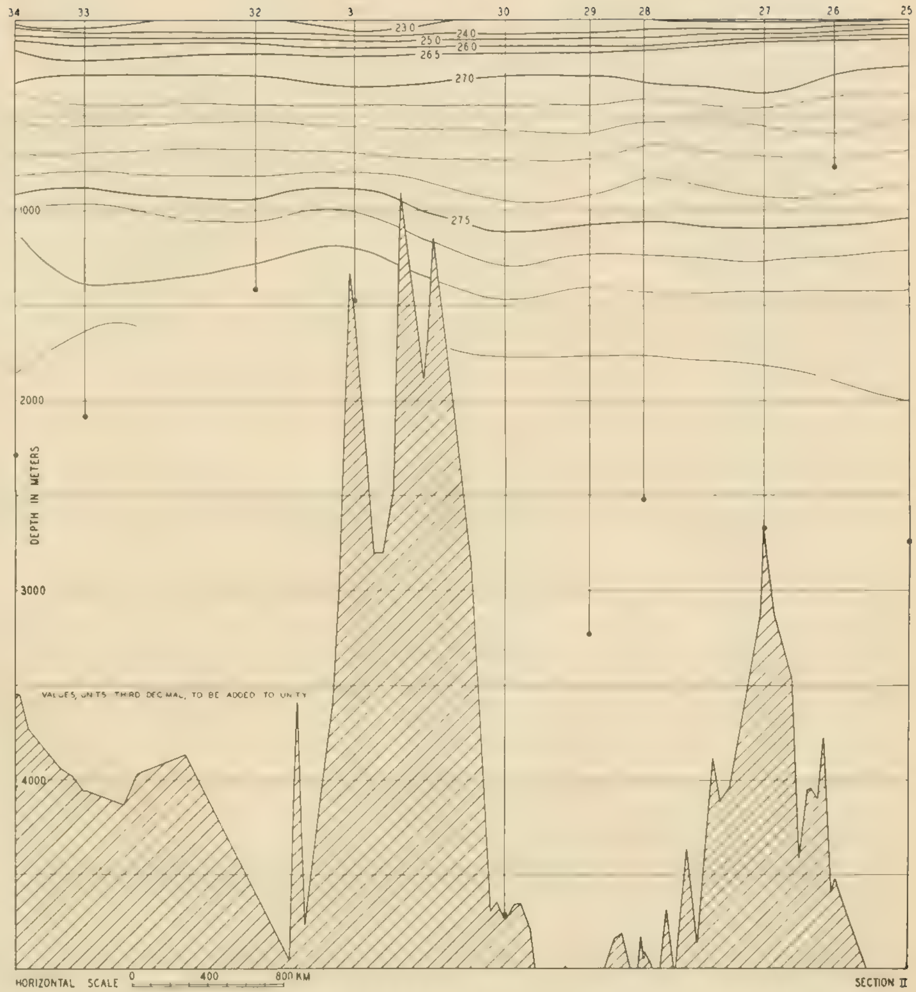


FIG 102—VERTICAL DISTRIBUTION DENSITY, ATLANTIC OCEAN, FROM *CARNEGIE* RESULTS, SEPTEMBER 3 TO OCTOBER 9, 1928

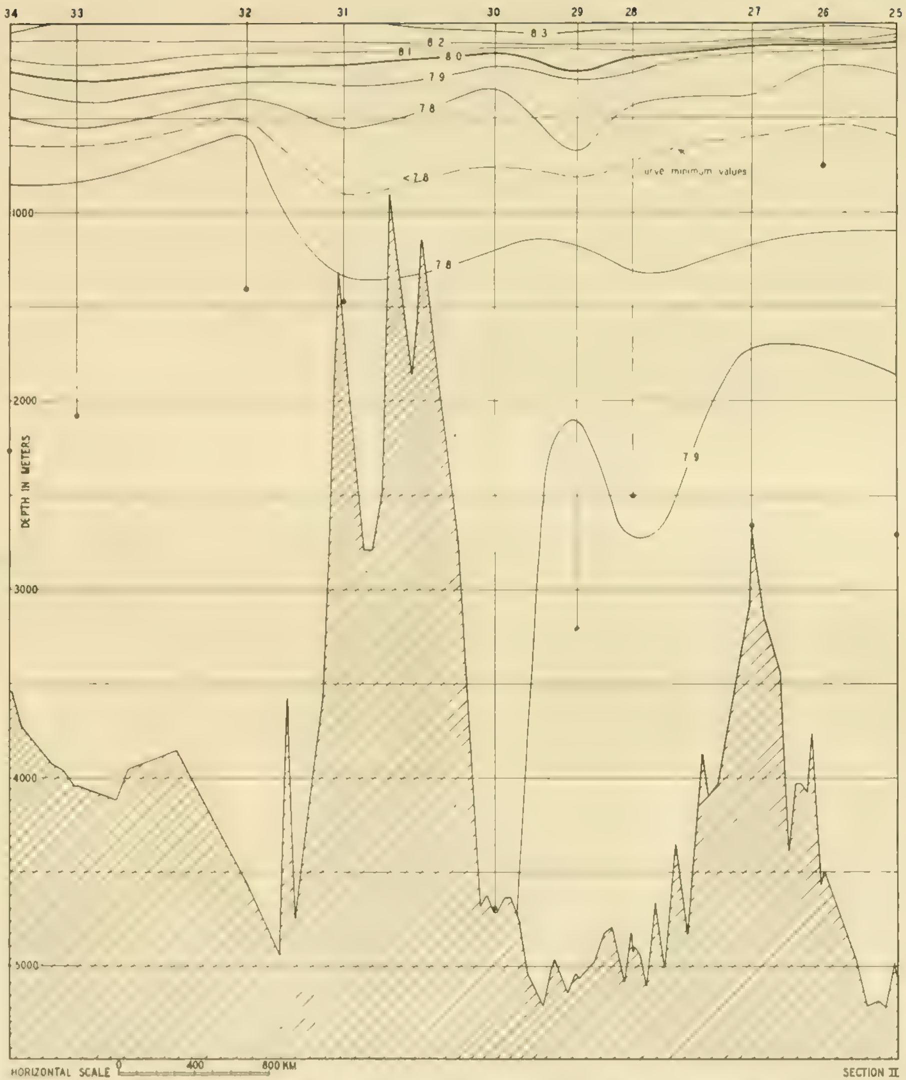


FIG. 103—VERTICAL DISTRIBUTION HYDROGEN ION, ATLANTIC OCEAN, FROM CARNEGIE RESULTS
SEPTEMBER 3 TO OCTOBER 9, 1928

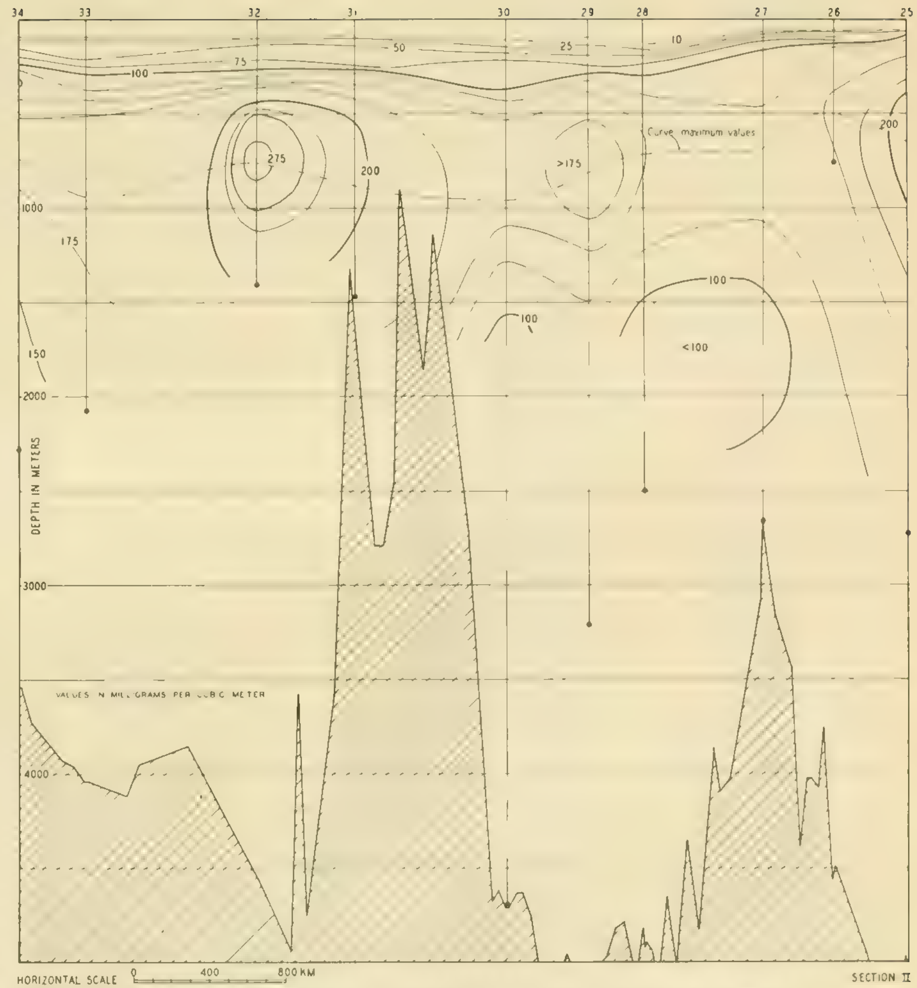


FIG. 104—VERTICAL DISTRIBUTION PHOSPHATE, ATLANTIC OCEAN FROM CARNEGIE RESULTS
SEPTEMBER 3 TO OCTOBER 9, 1928

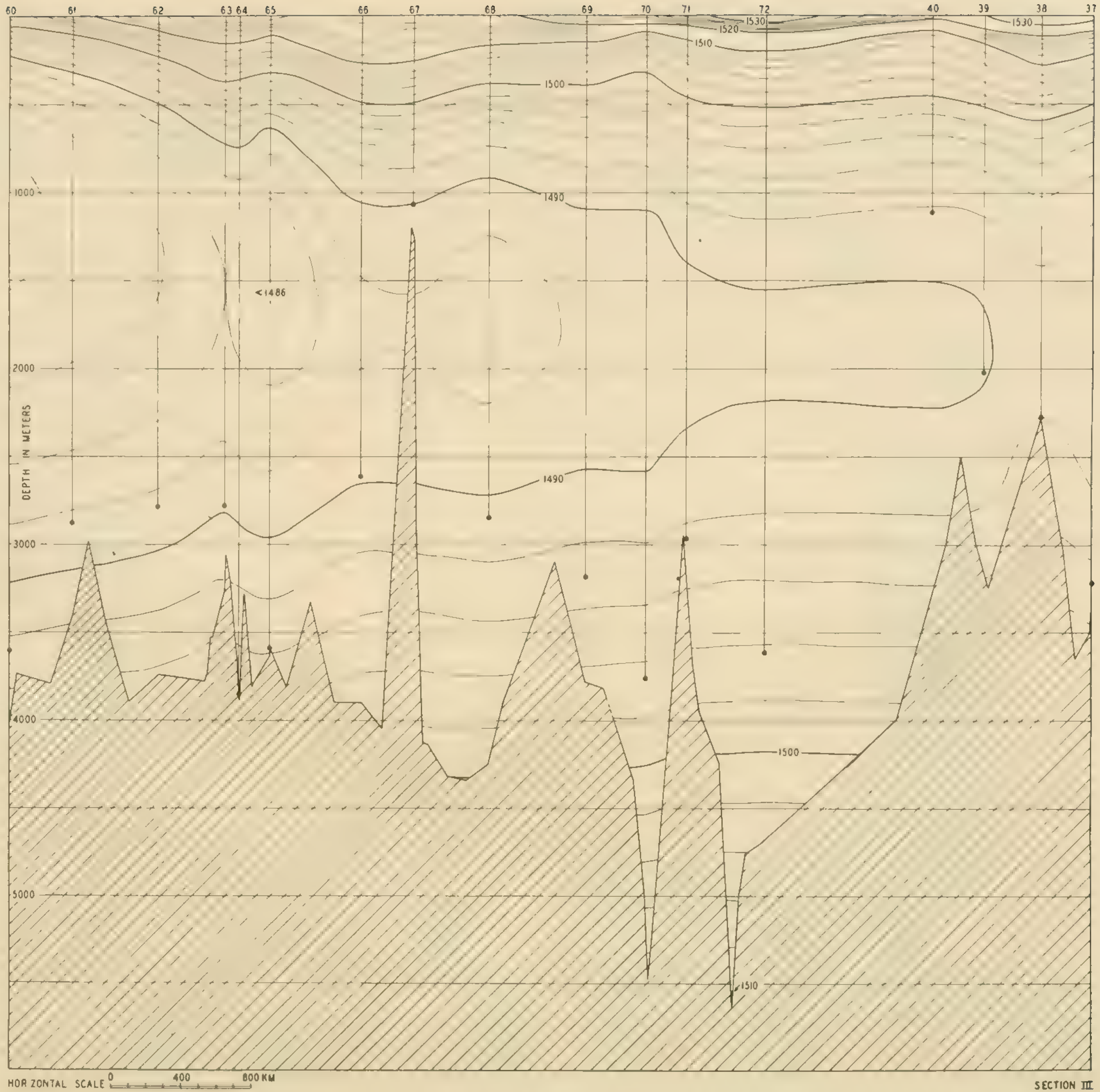


FIG 105—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 1–8, 1928, AND DECEMBER 26, 1928, TO FEBRUARY 8, 1929

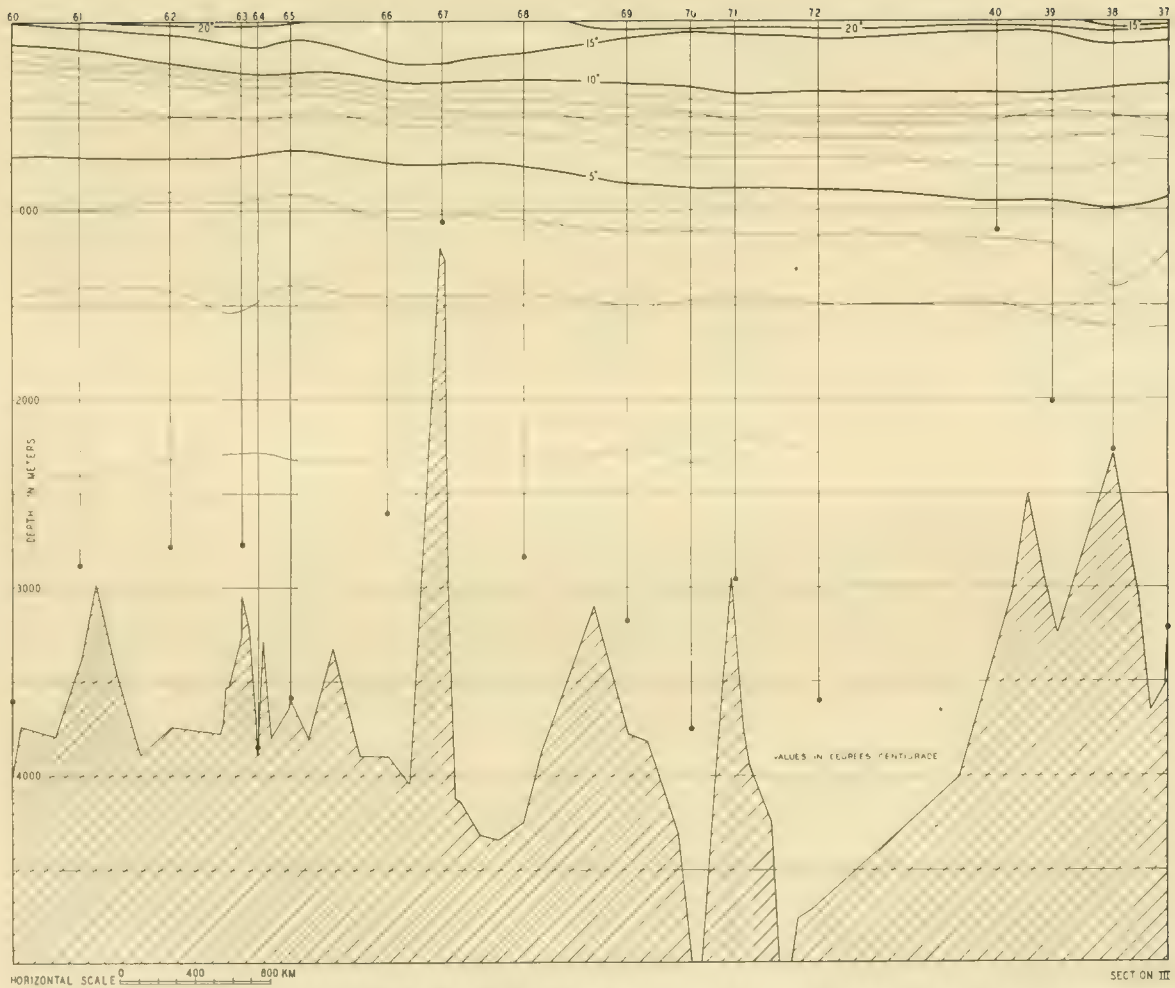


FIG 106-VERTICAL DISTRIBUTION TEMPERATURE PACIFIC OCEAN FROM CARNEGIE REPORT, NOVEMBER 18, 1928 AND DECEMBER 26, 1928 TO FEBRUARY 8, 1929

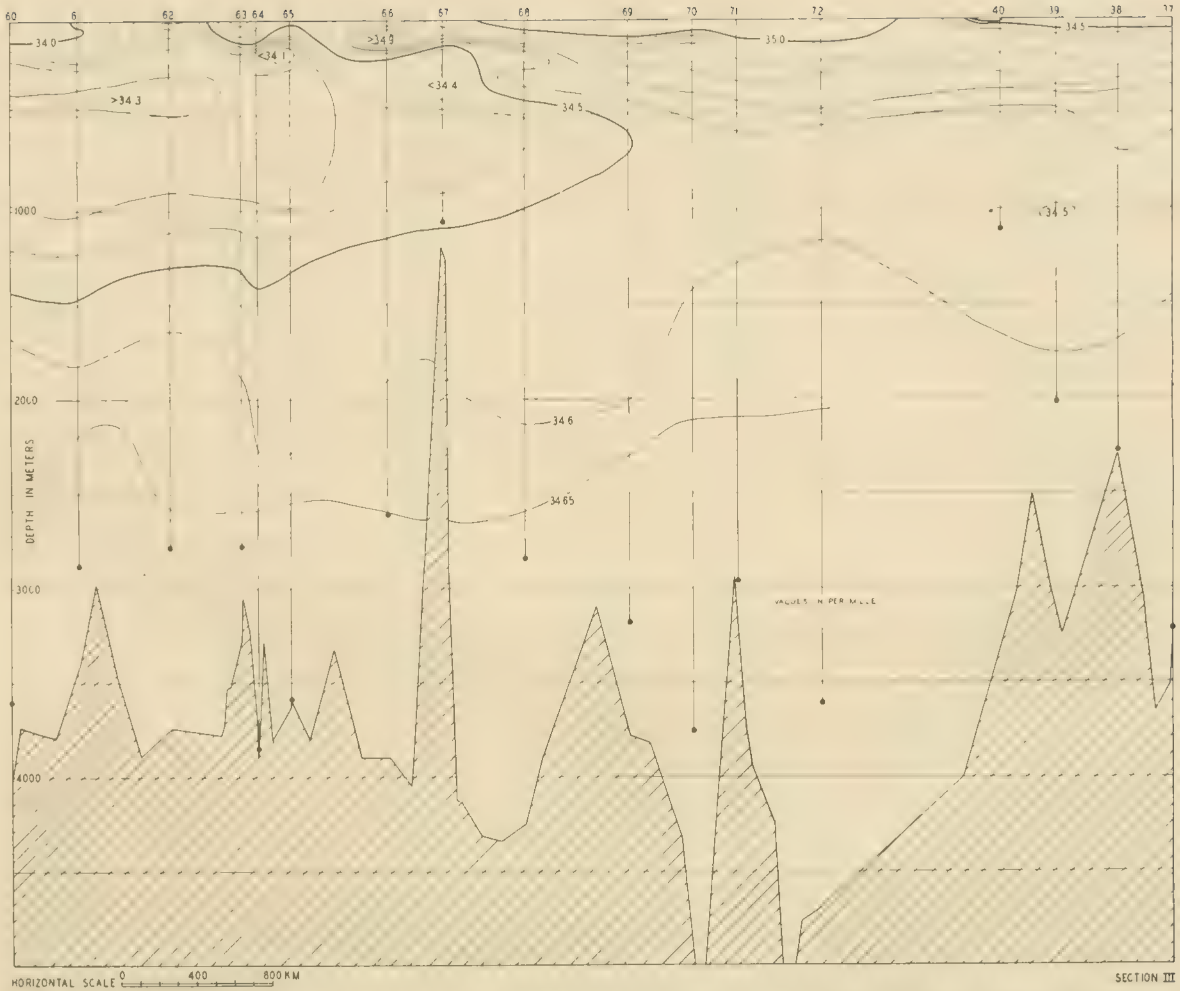
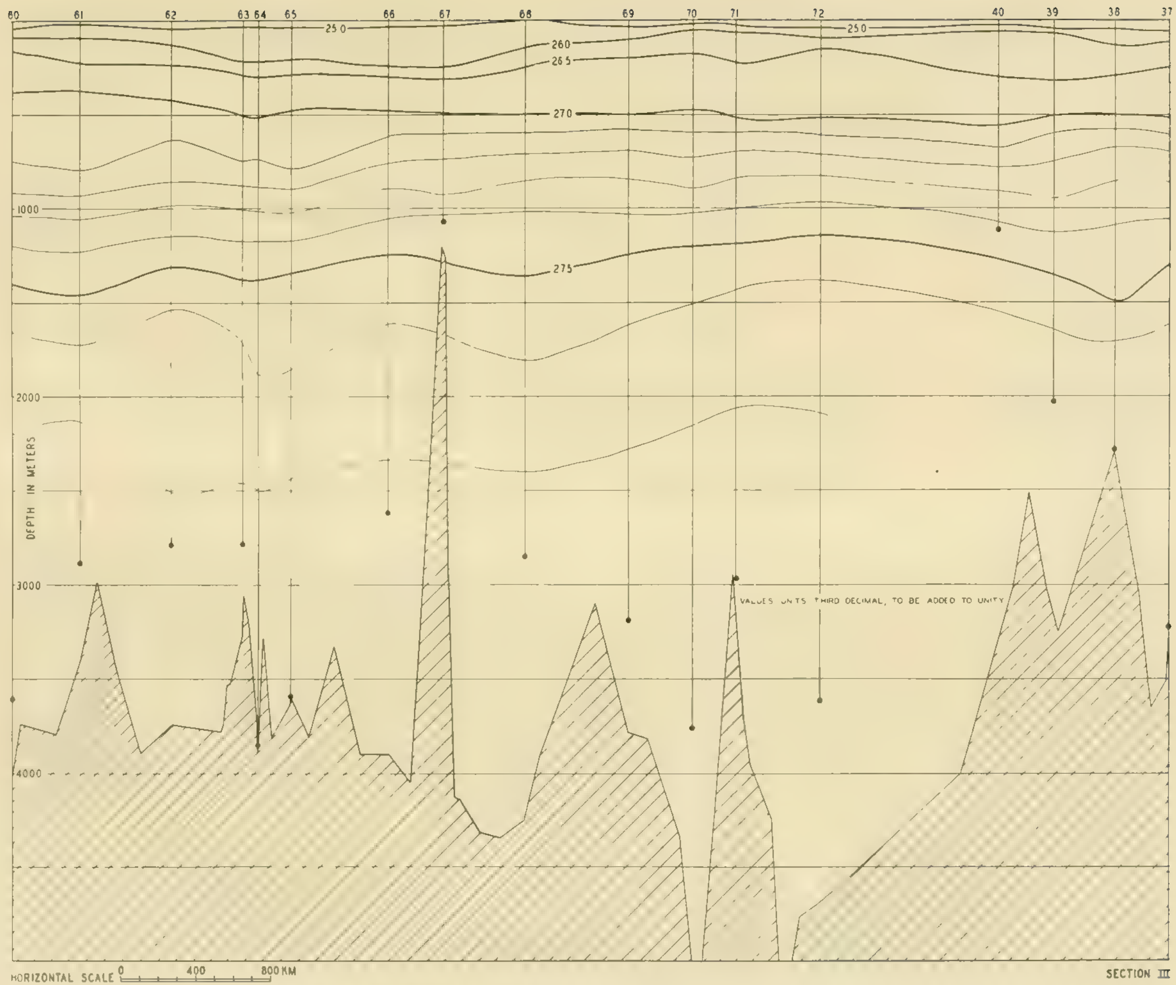


FIG. [illegible]—VERTICAL DISTRIBUTION SALINITY PACIFIC OCEAN, FROM JAPANESE RESULTS, NOVEMBER [illegible]-9, 1928 AND DECEMBER 26, 1928 TO FEBRUARY 9, 1929



[illegible] CARNEGIE RESULTS, NOVEMBER 1-8, 1928 AND DECEMBER 26, 1928 TO FEBRUARY 8, 1929

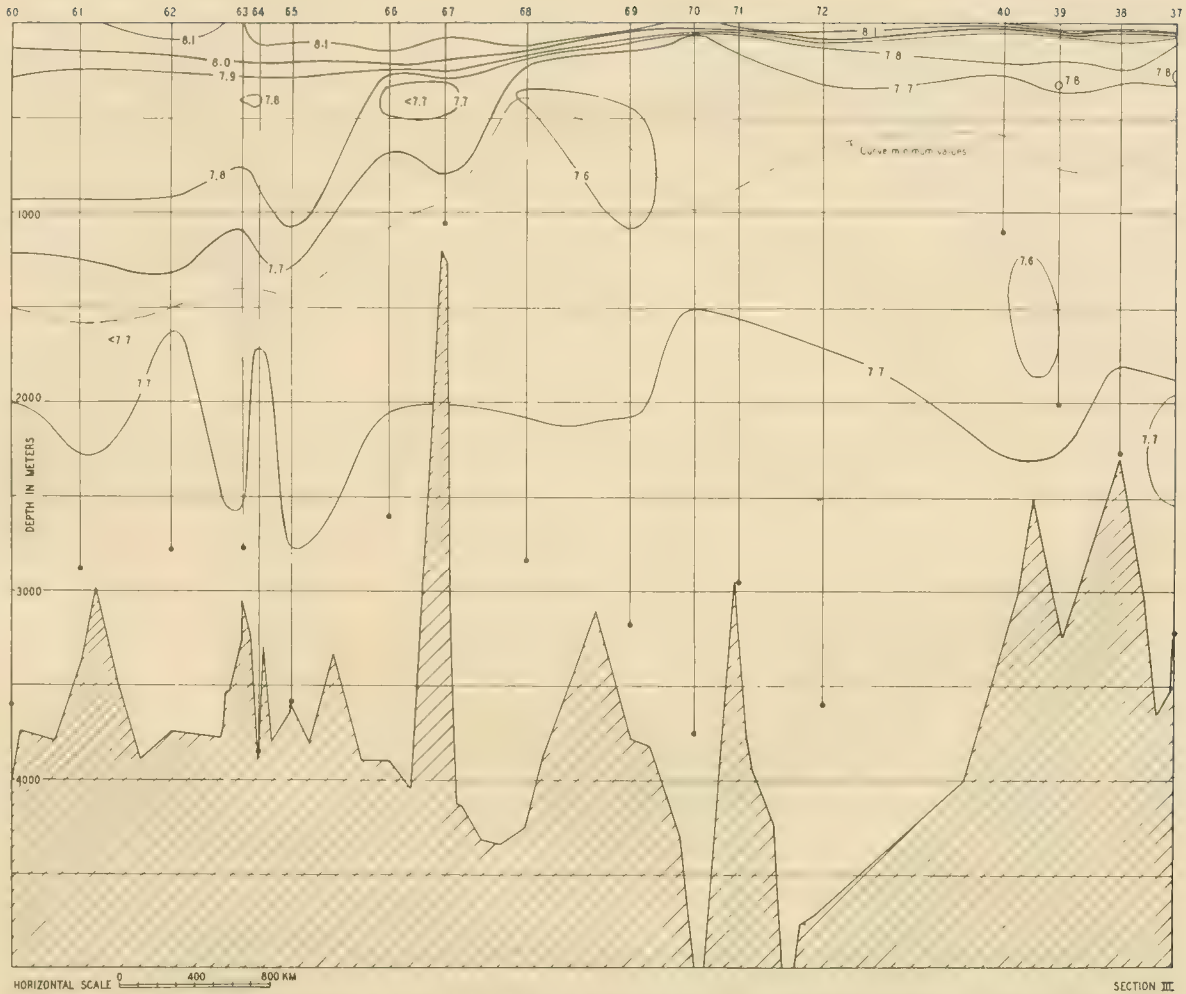


FIG. 69 VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS NOVEMBER 1-8, 1928, AND DECEMBER 26, 1928, TO FEBRUARY 8, 1929

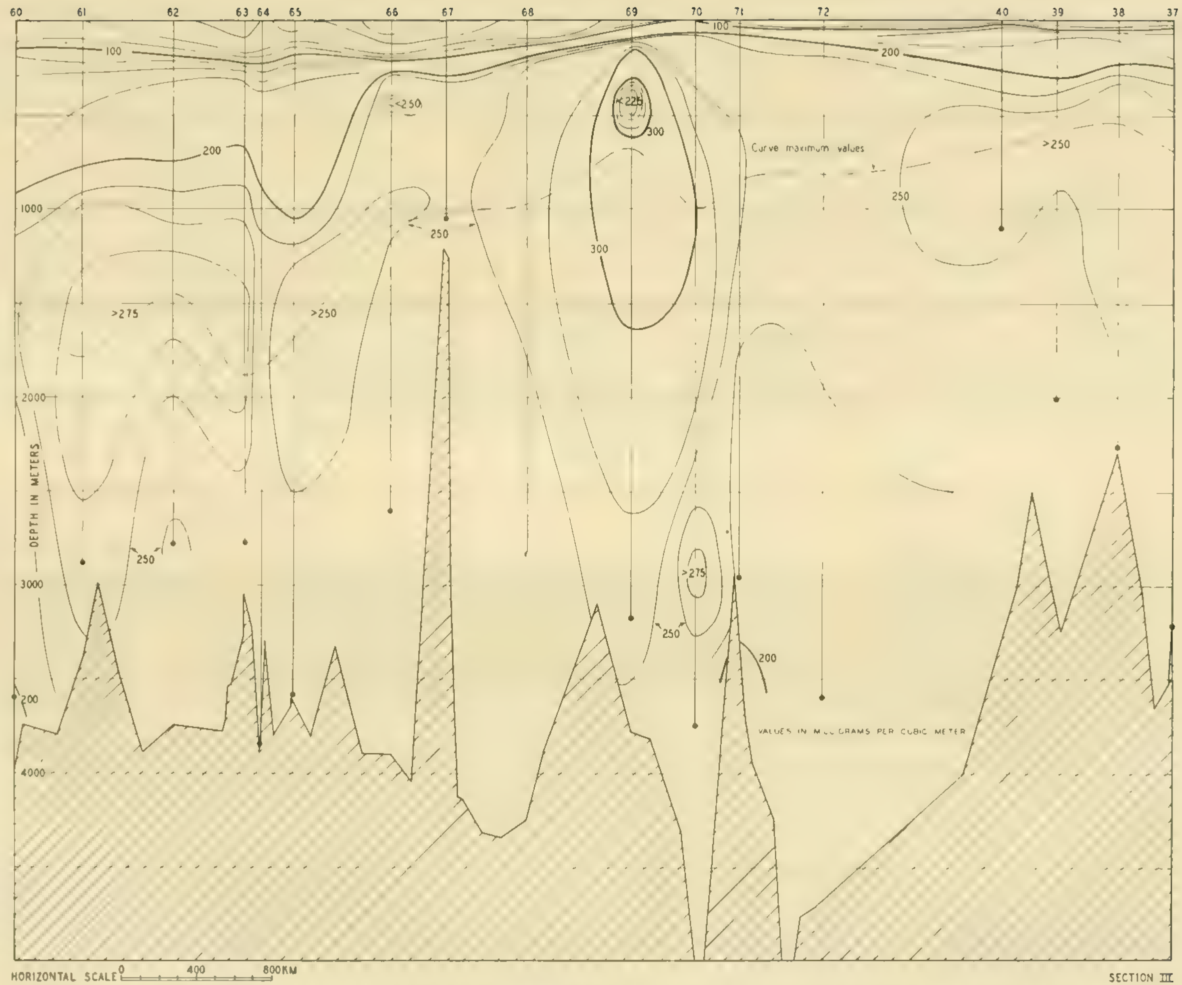


FIG. 110—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER [illegible]-8, 1929, AND DECEMBER 26, 1928, TO FEBRUARY 8, 1929

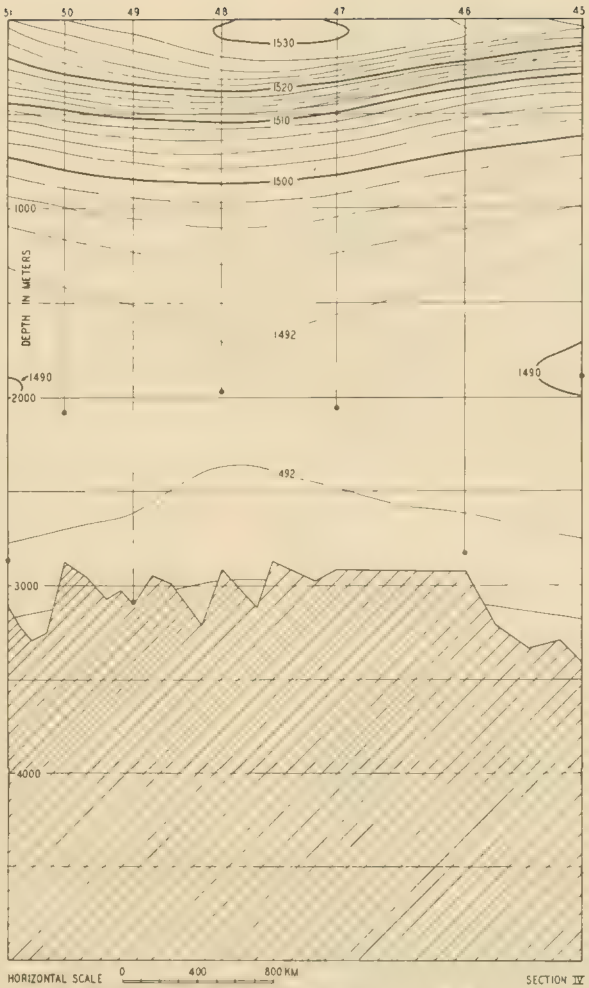


FIG. 11—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 9 TO DECEMBER 1928

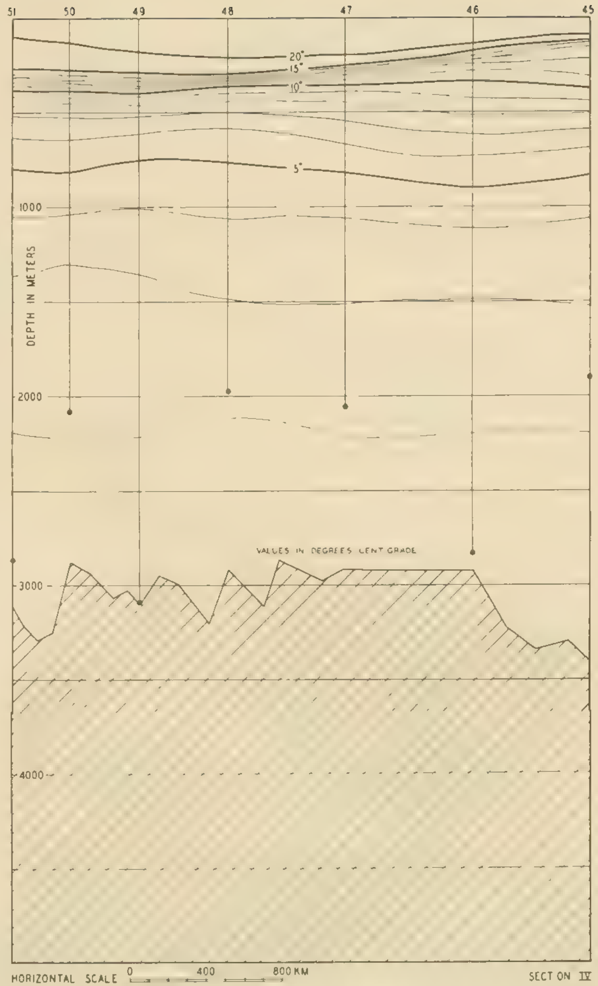


FIG. 12—VERTICAL DISTRIBUTION TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 9 TO DECEMBER 1928

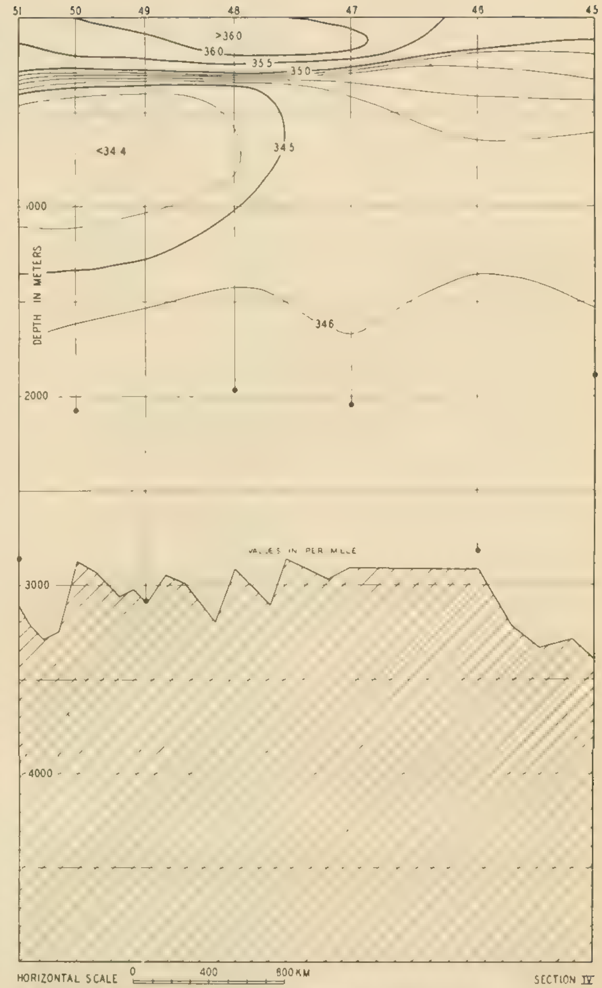


FIG. 13—VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 9 TO DECEMBER 1928

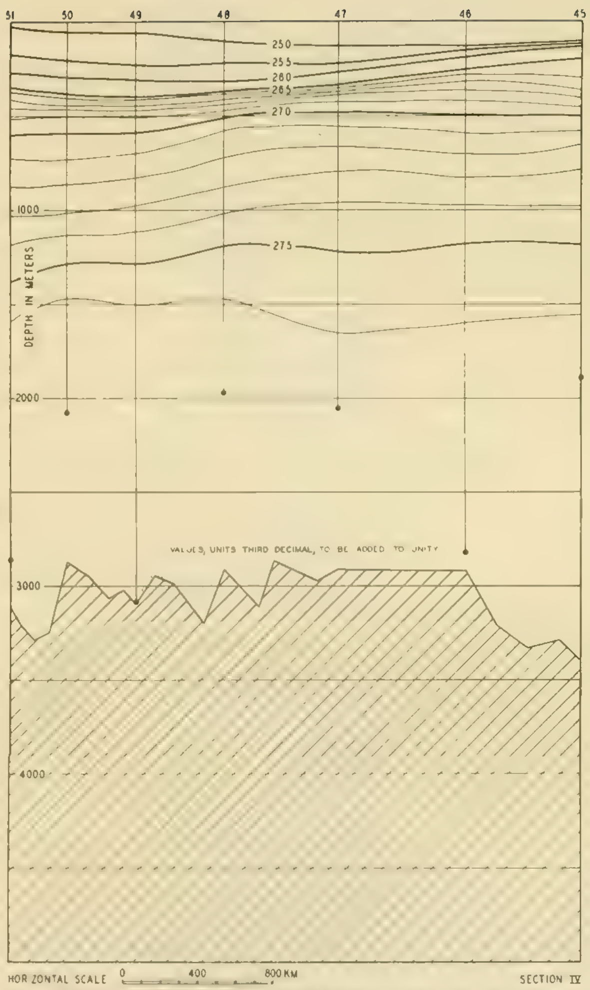


FIG. 14—VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 19 TO SEPTEMBER 4, 1929

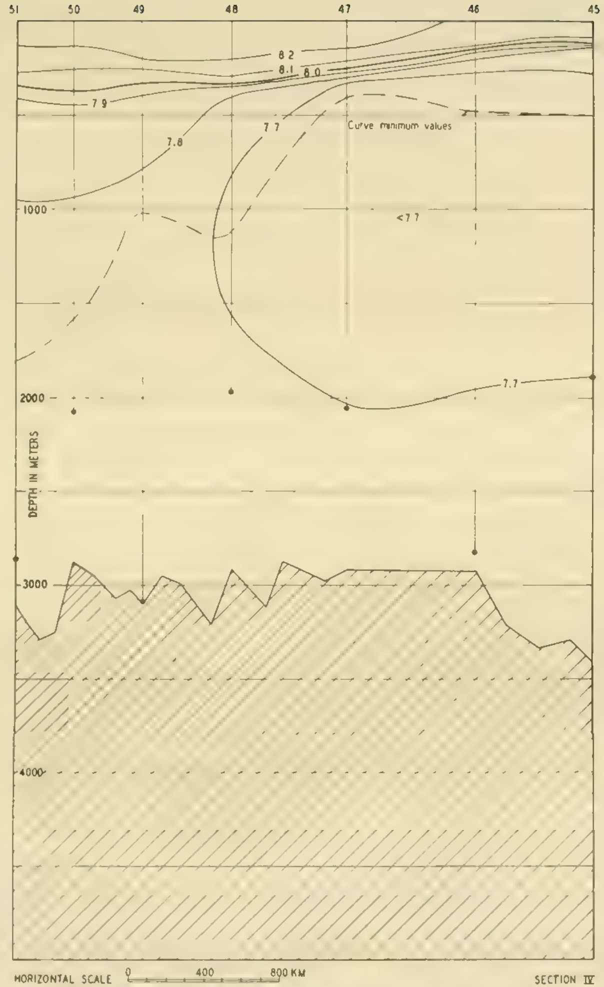


FIG. 15—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 19 TO DECEMBER 1, 1929

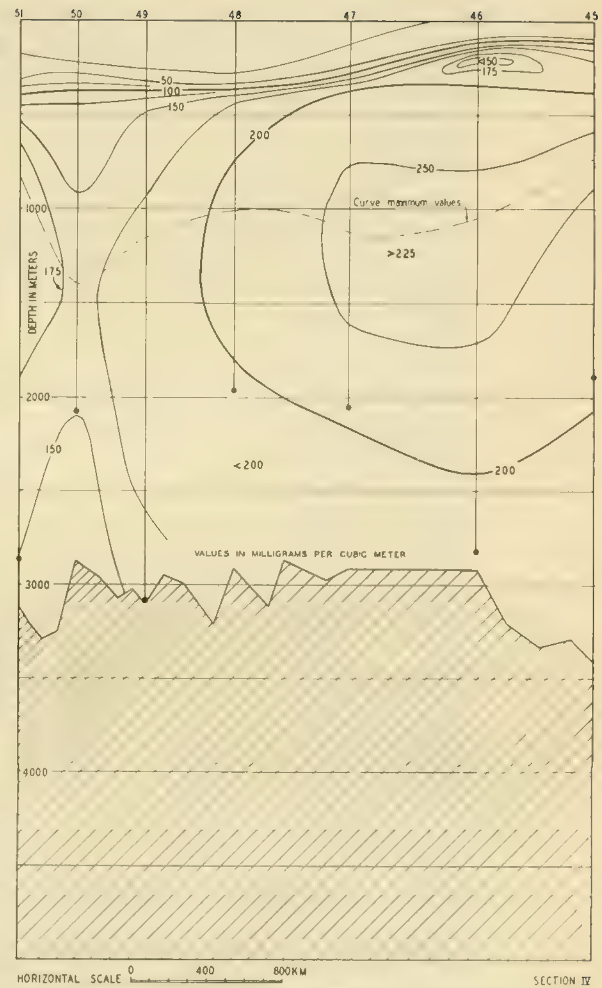


FIG. 16—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 19 TO DECEMBER 1, 1928

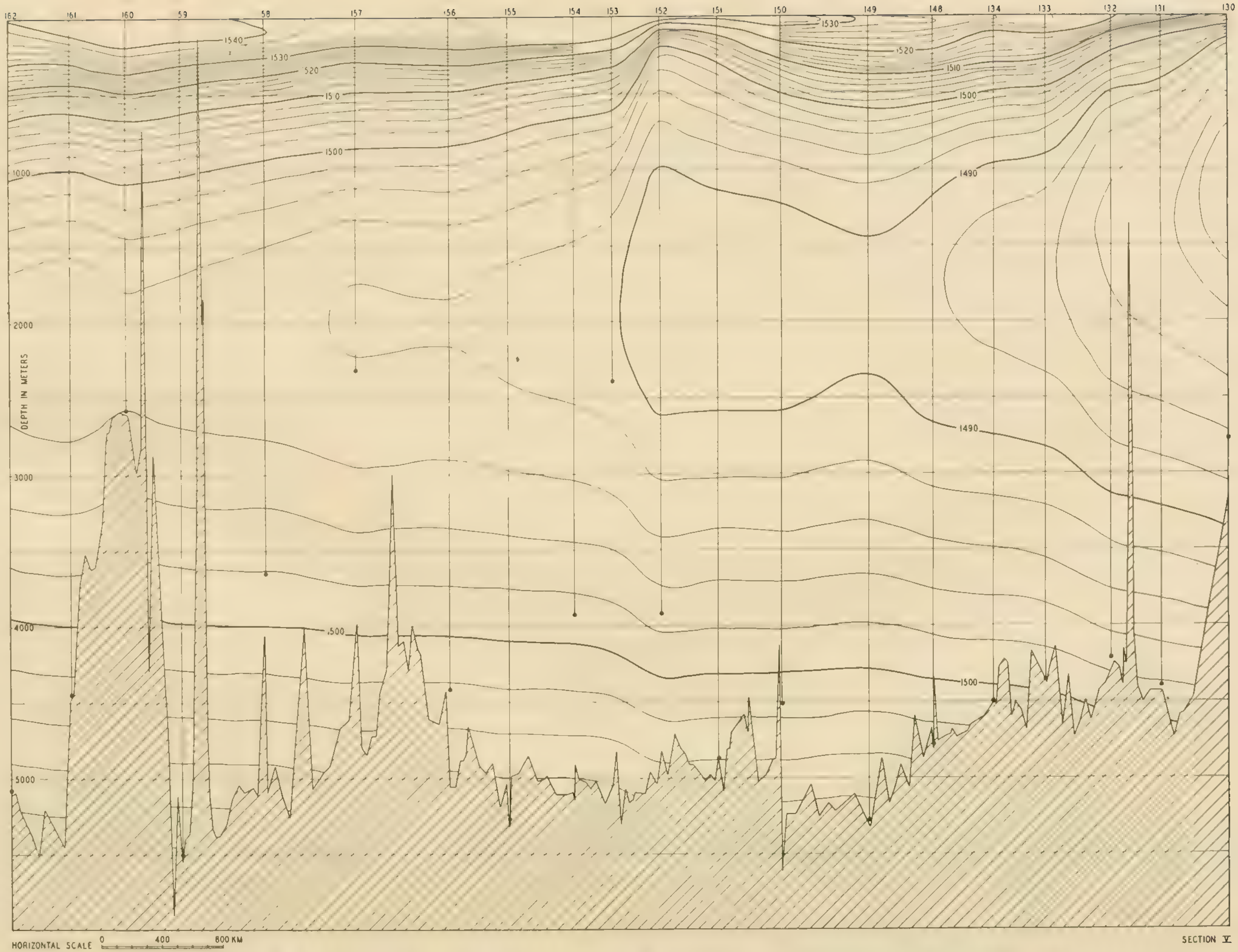


FIG. 117—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM *CARNEGIE* RESULTS, SEPTEMBER 4-12, AND OCTOBER 19 TO NOVEMBER 17, 1929

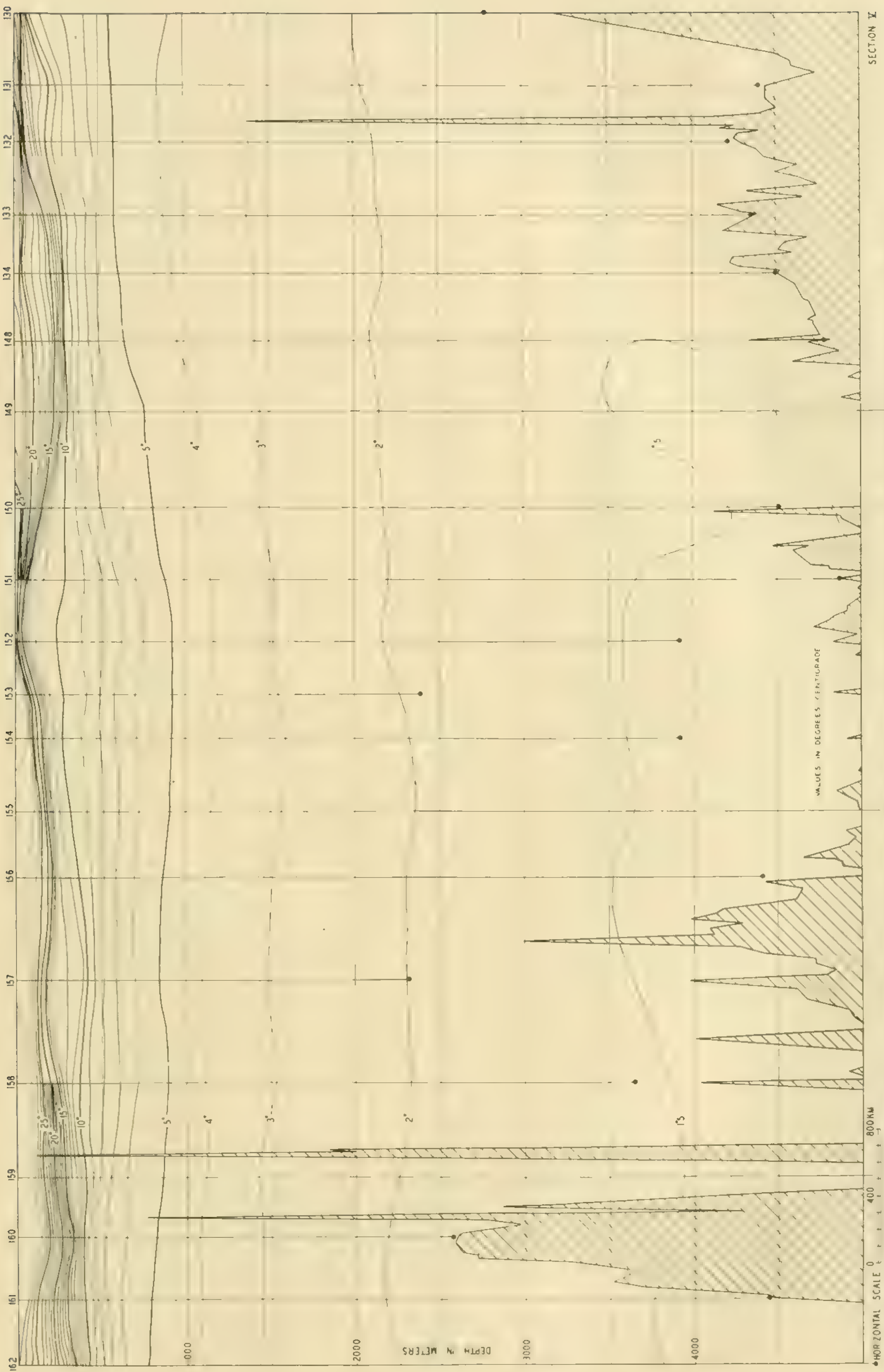


FIG. 8 VERTICAL DISTRIBUTION IN TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS SEPTEMBER 4 TO ..., AND OCTOBER 2 TO NOVEMBER 7

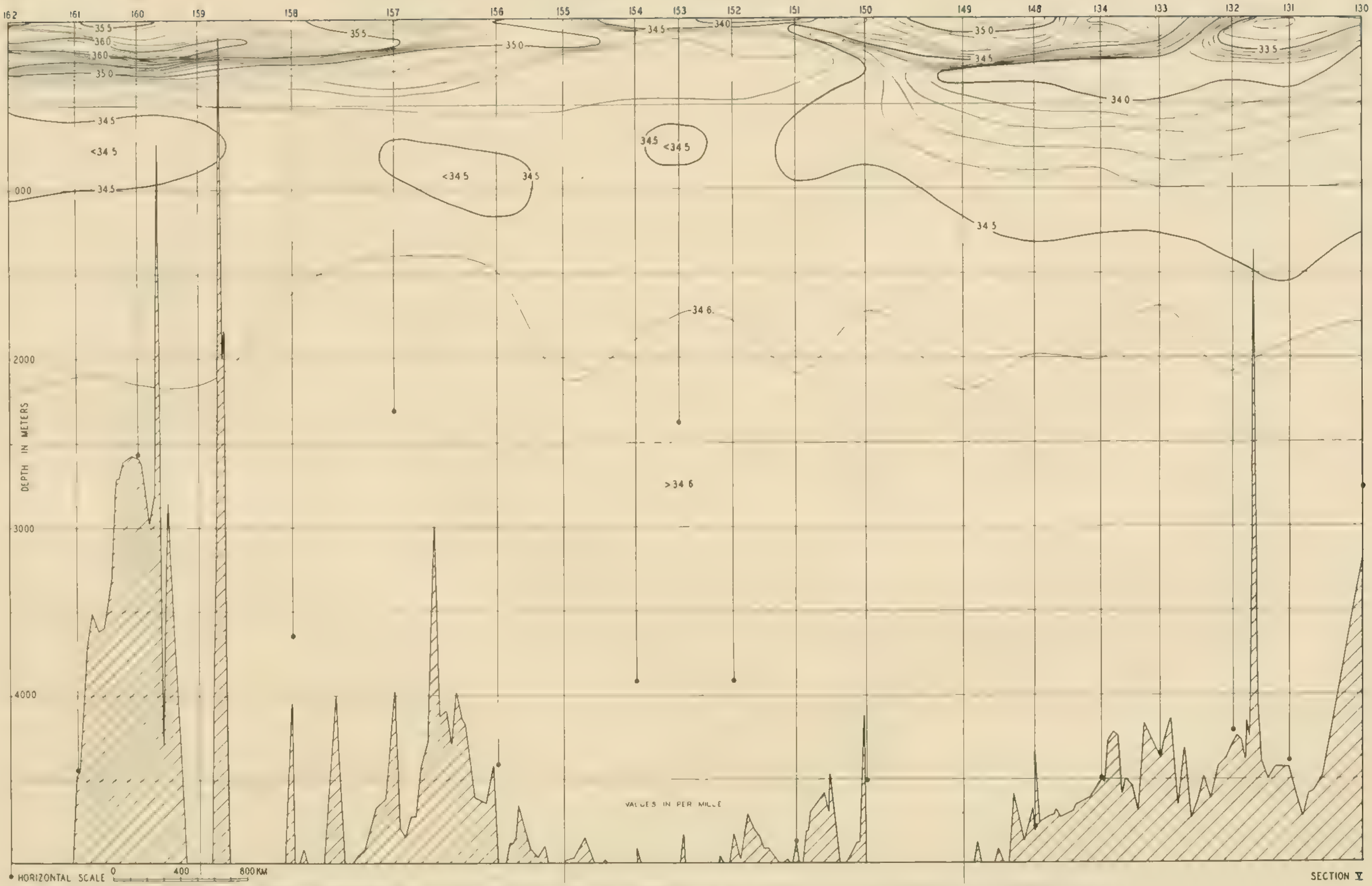


FIG. 119 VERTICAL DISTRIBUTION OF SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS SEPTEMBER 4-2, AND OCTOBER 19 TO NOVEMBER 17, 1929

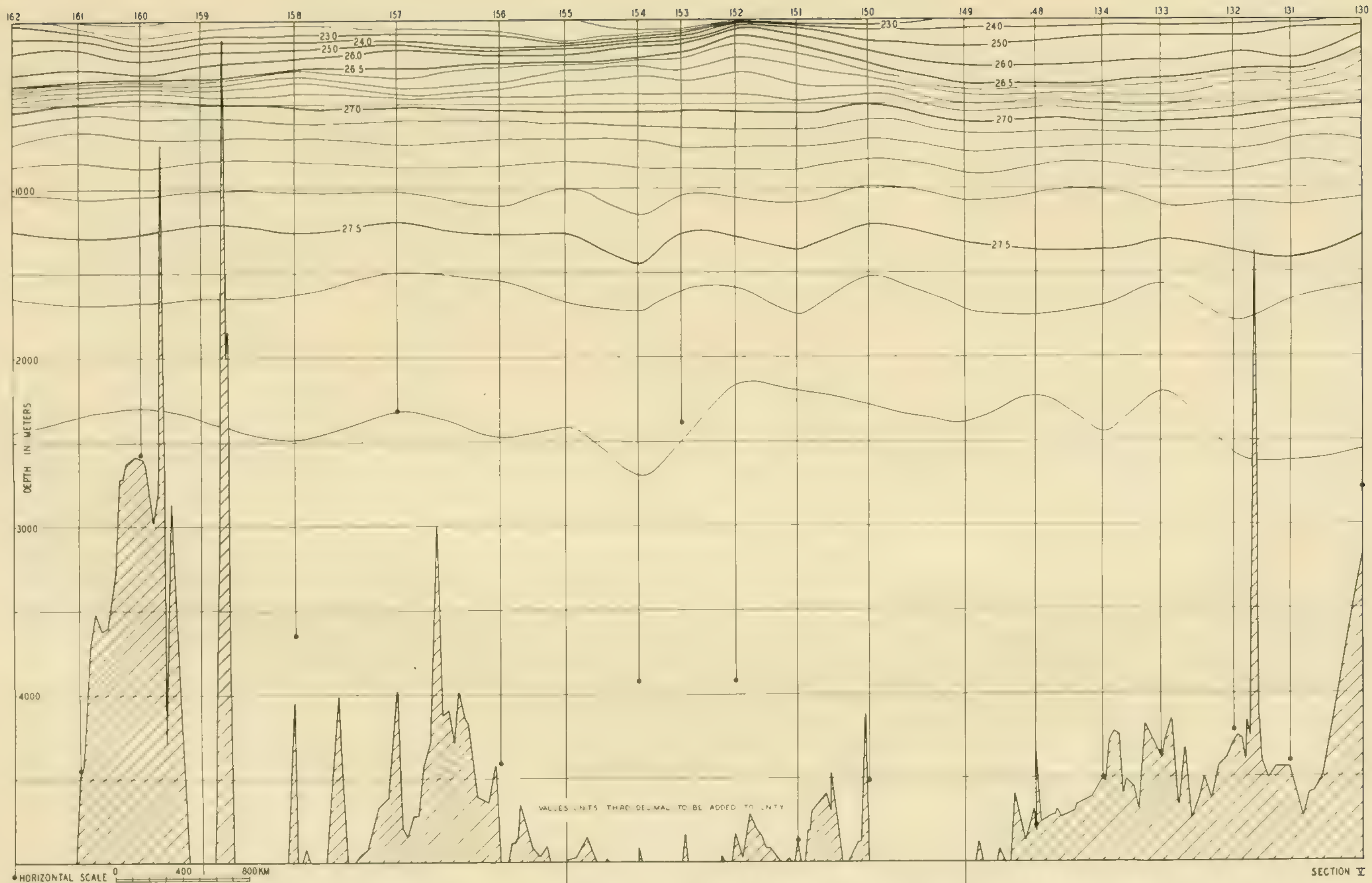


FIG. 20 VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN FROM CARNEGIE RESULTS, SEPTEMBER 4-12 AND OCTOBER 19 TO NOVEMBER 7, 1929

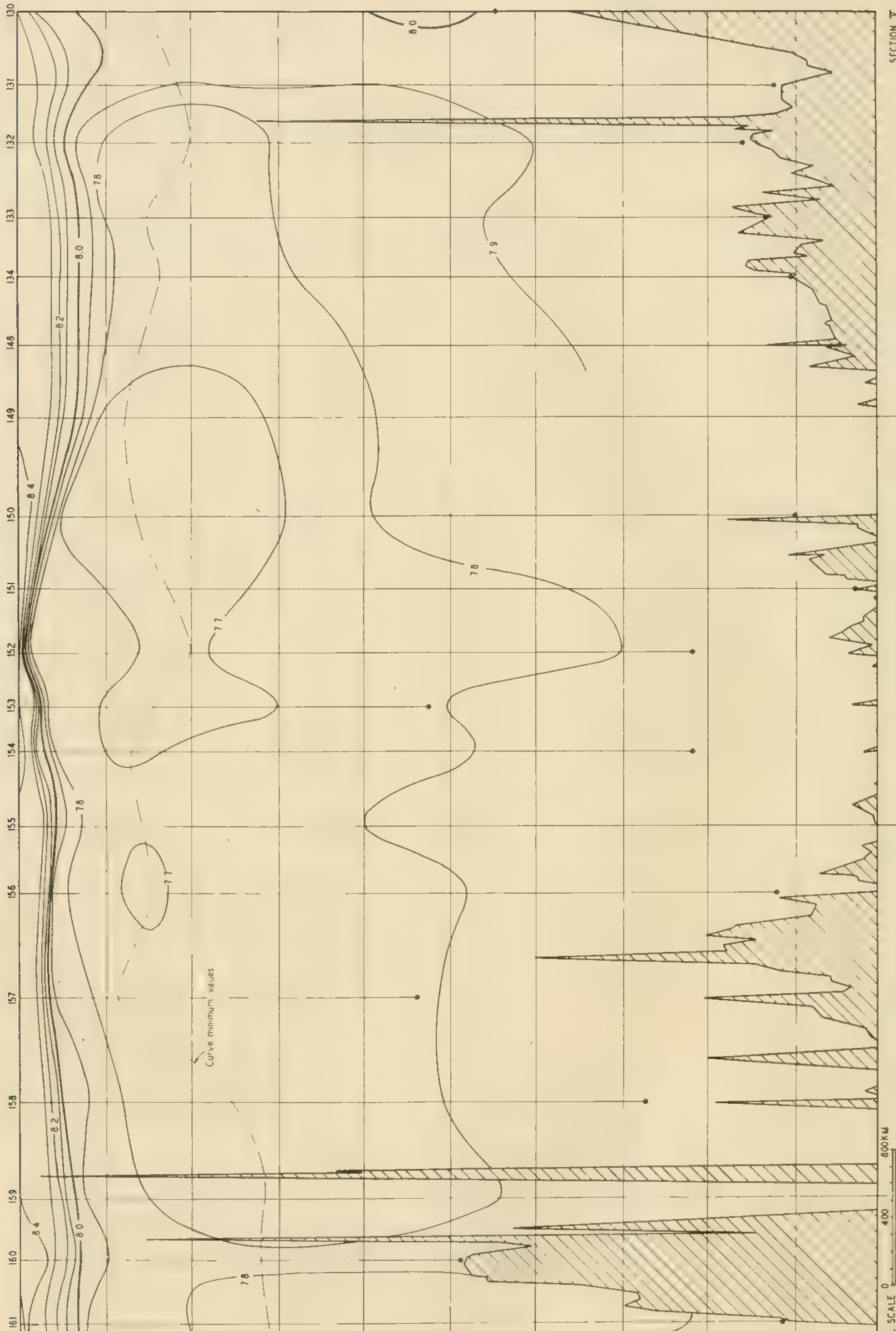


FIG 121—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS SEPTEMBER 4-12, AND OCTOBER 19 TO NOVEMBER 17, 1929

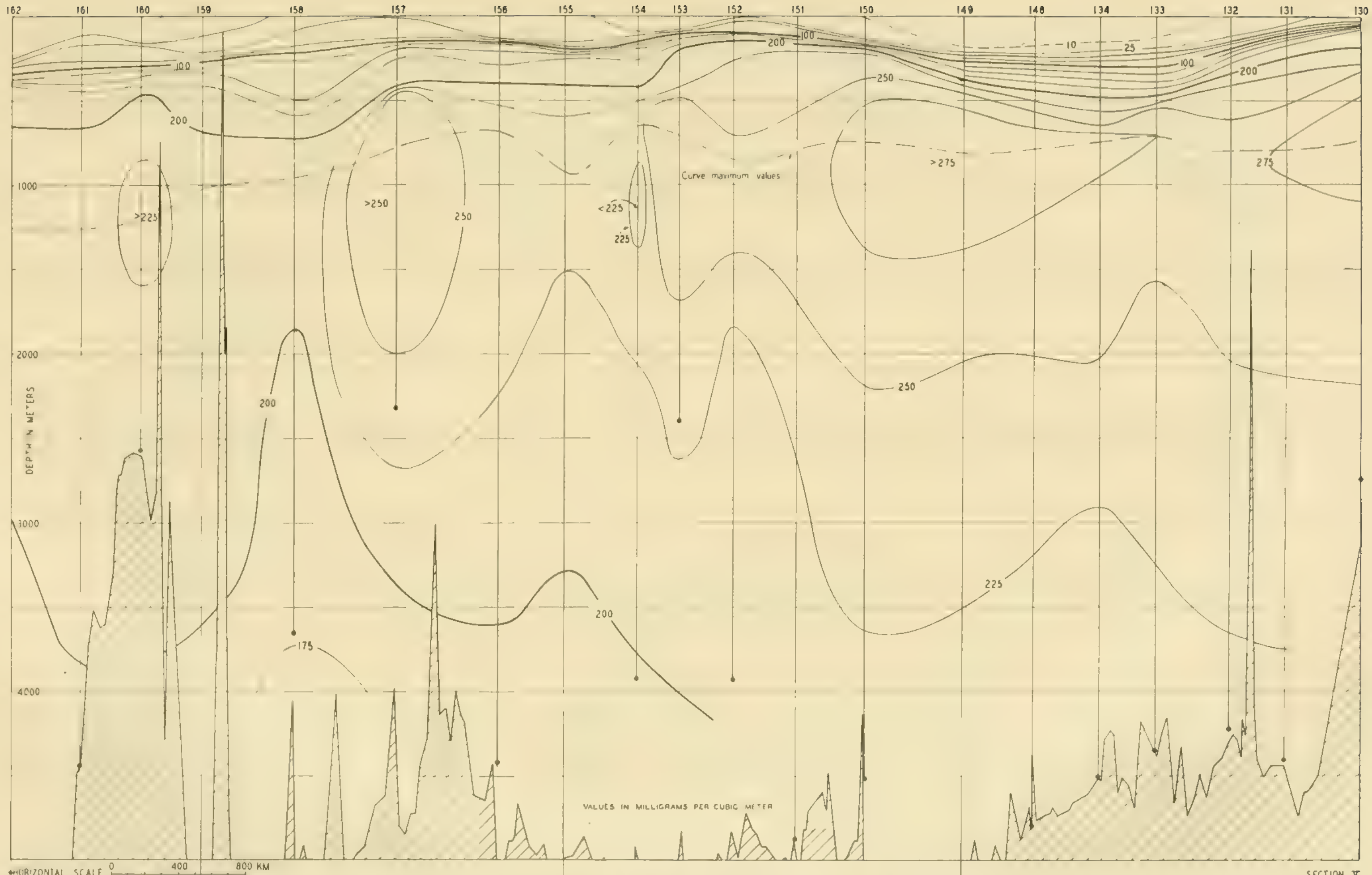


FIG. 12. VERTICAL DISTRIBUTION PHOSPHATE PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 4–12, AND OCTOBER 19 TO NOVEMBER 7, 1929

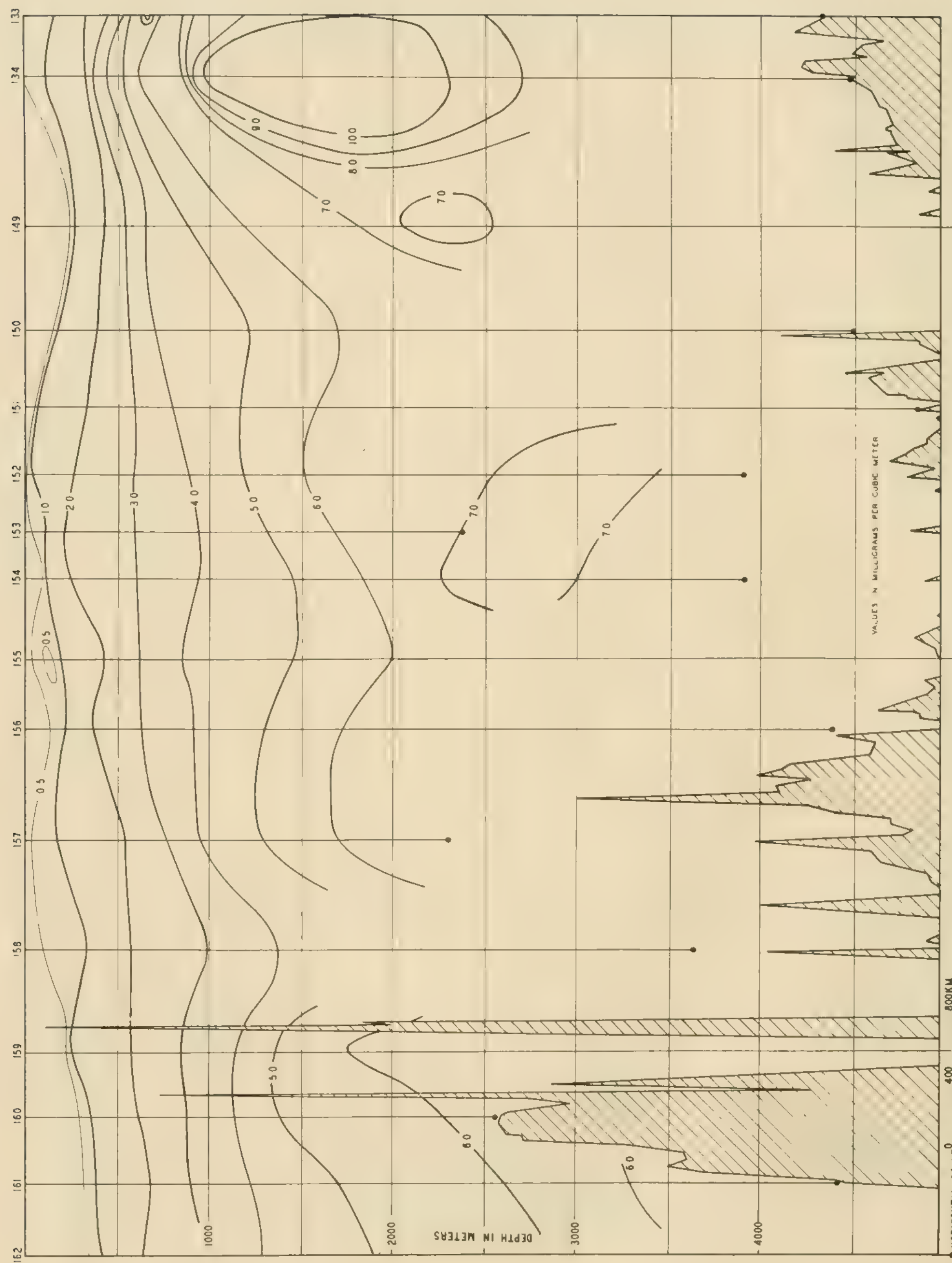


FIG 123–VERTICAL DISTRIBUTION SILICA, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 10-12, AND OCTOBER 19 TO NOVEMBER 17, 1929

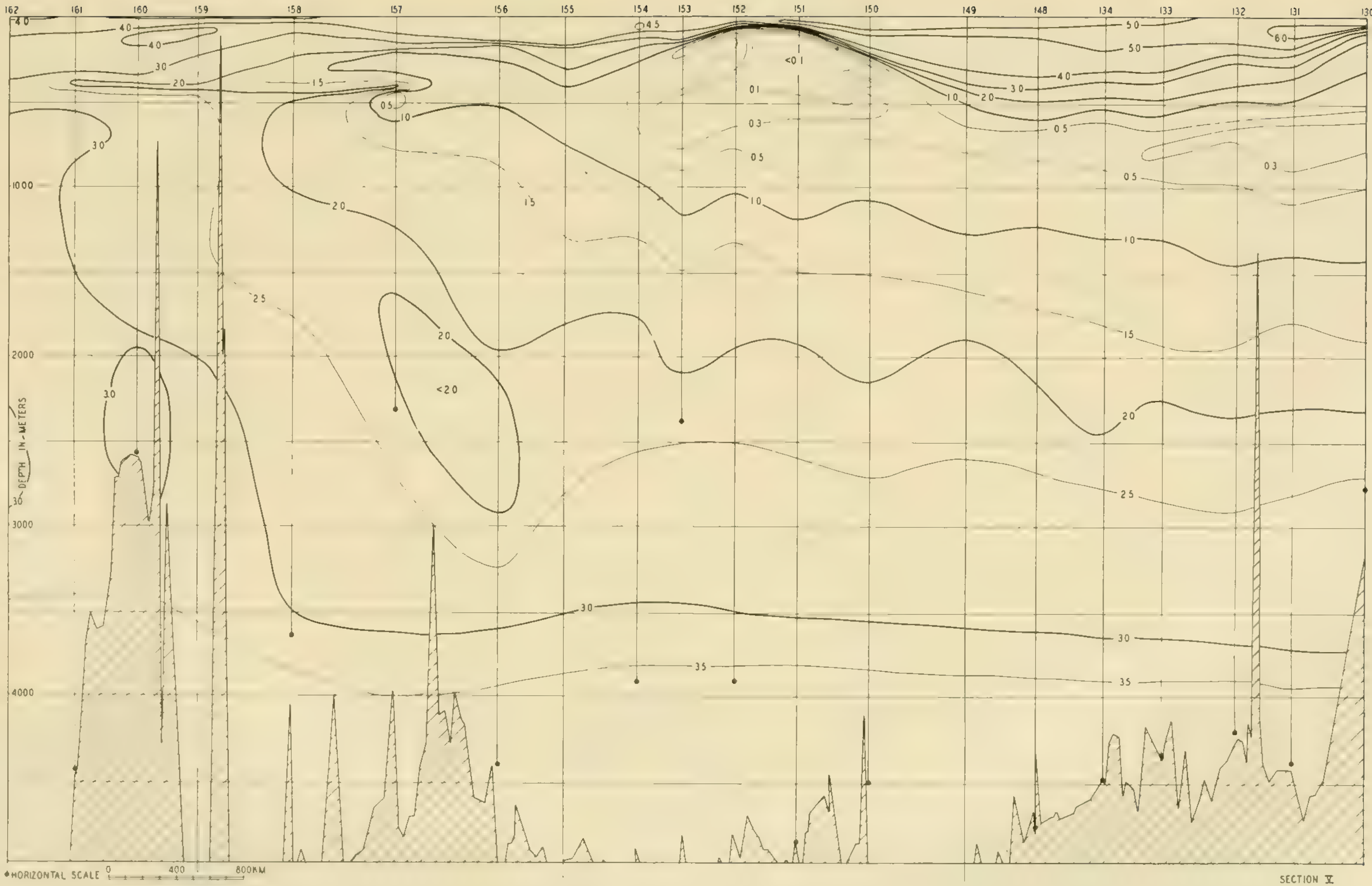


FIG 124—VERTICAL DISTRIBUTION OXYGEN IN MILLILITERS PER LITER, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 4-12, AND OCTOBER 19 TO NOVEMBER 17 1929

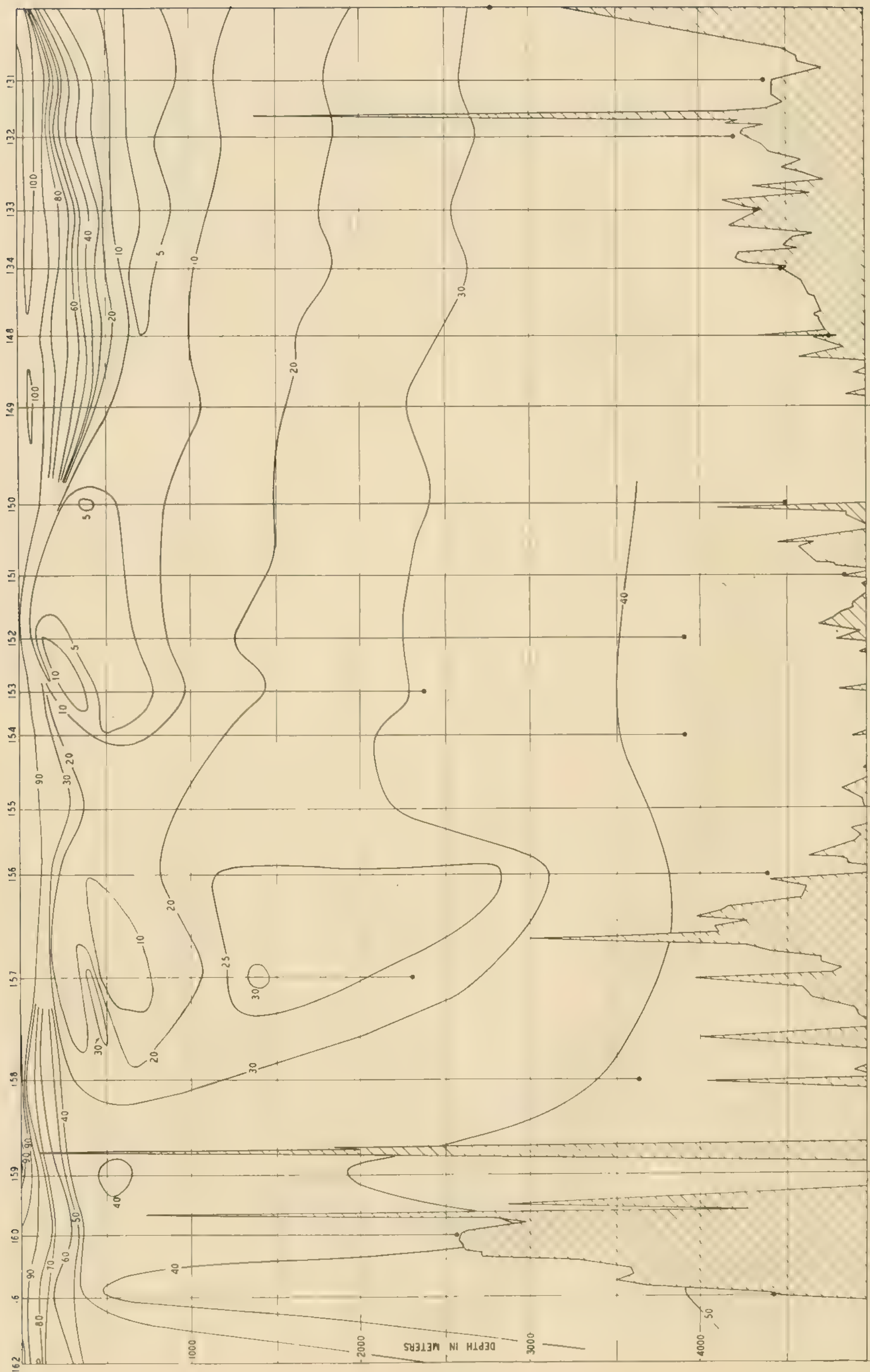


FIG. 125—VERTICAL DISTRIBUTION OXYGEN SATURATION IN PER CENT, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 4-12, AND OCTOBER 19 TO NOVEMBER 17, 1929

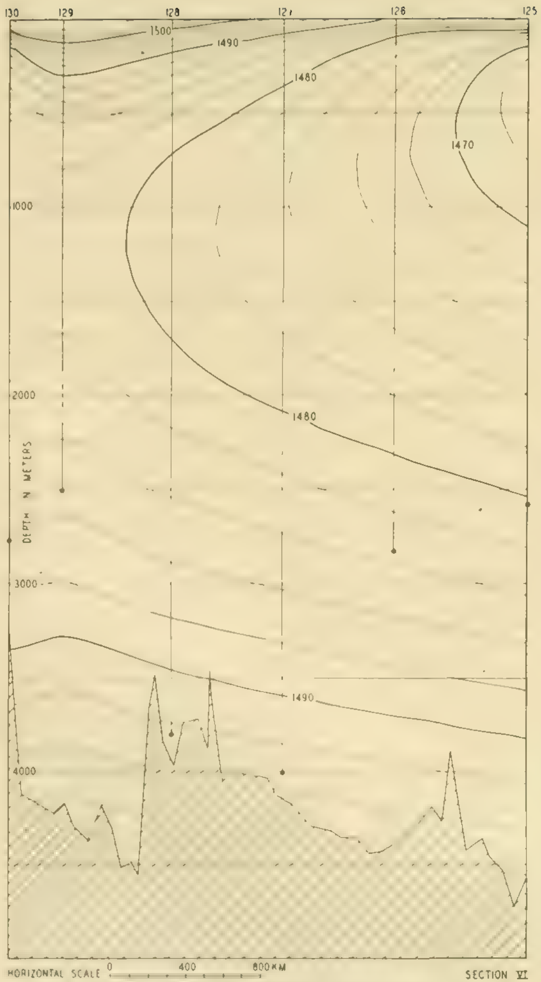


FIG. [illegible]—VERTICAL DISTRIBUTION [illegible] VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 19 TO SEPTEMBER 4, 1929

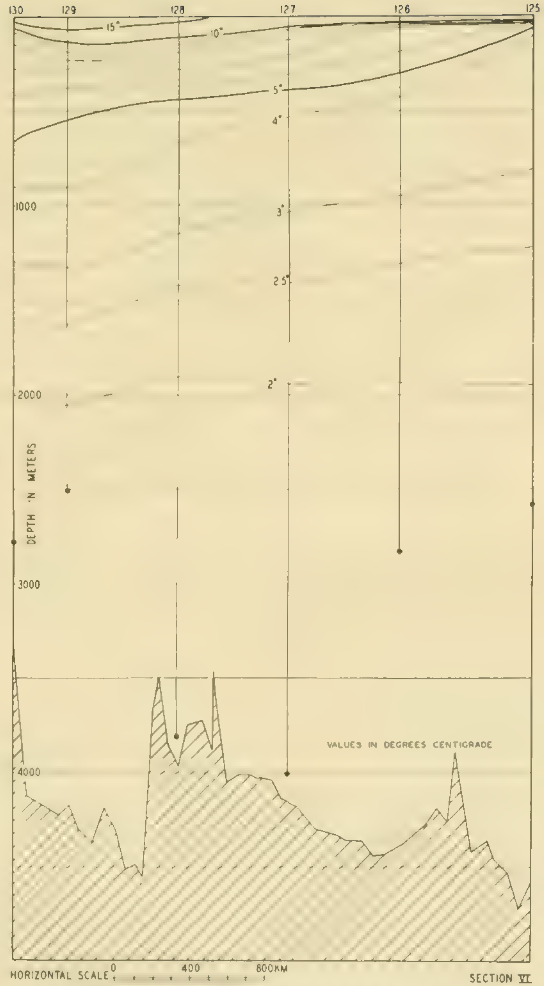


FIG. 27—VERTICAL DISTRIBUTION TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 19 TO SEPTEMBER 4, 1929

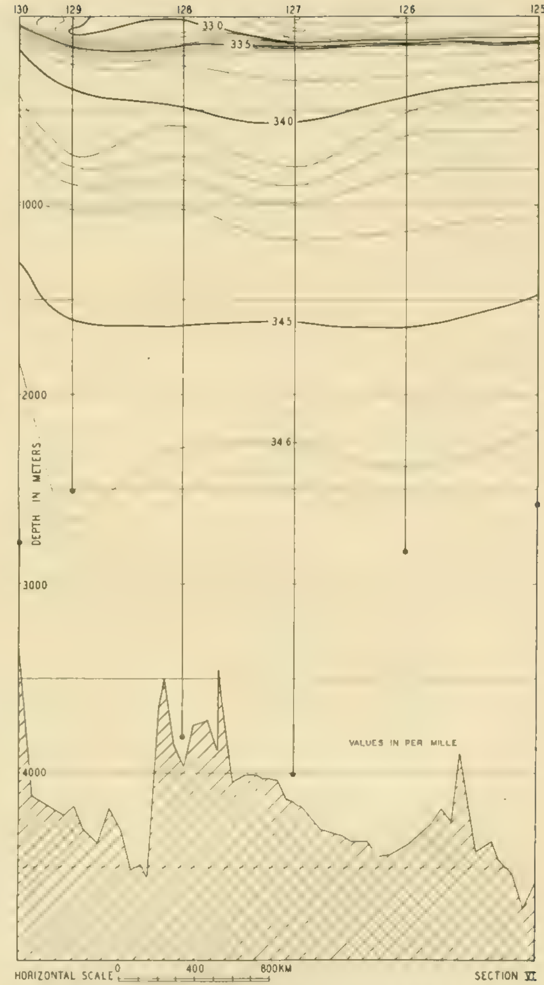


FIG. 28—VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 19 TO SEPTEMBER 4, 1929

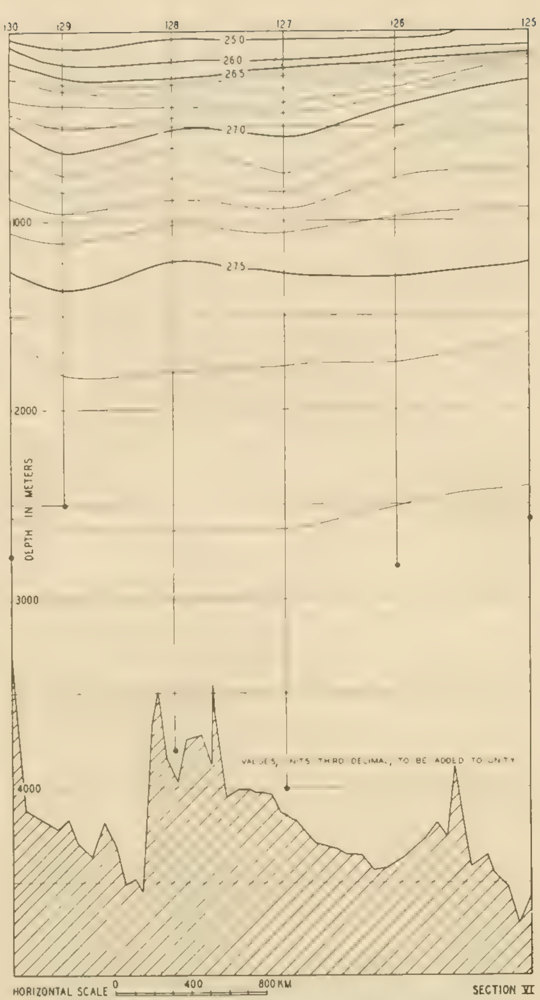


FIG. 129 VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN,
FROM CARNEGIE RESULTS, JULY 19 TO SEPTEMBER 4, 1929

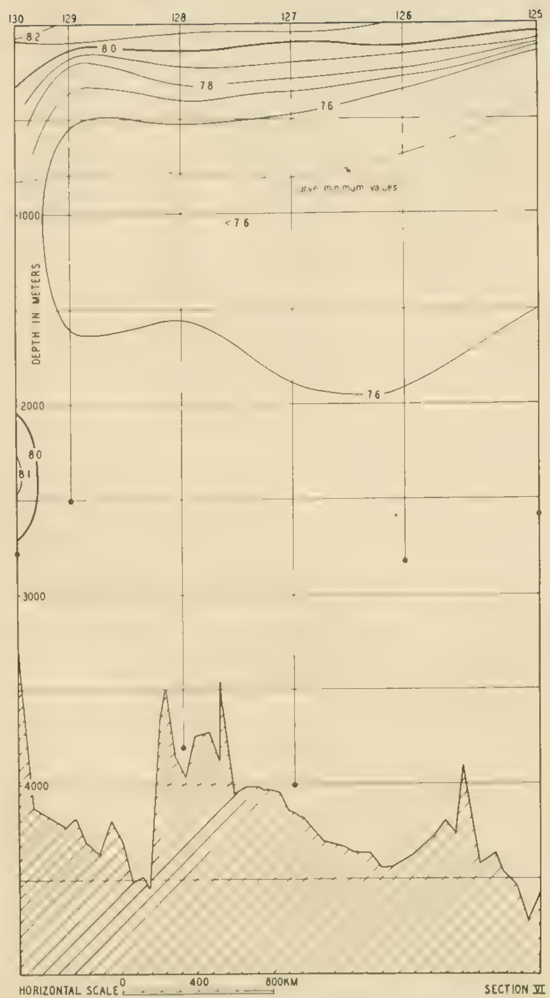


FIG. 130—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN,
FROM CARNEGIE RESULTS, JULY 19 TO SEPTEMBER 4, 1929

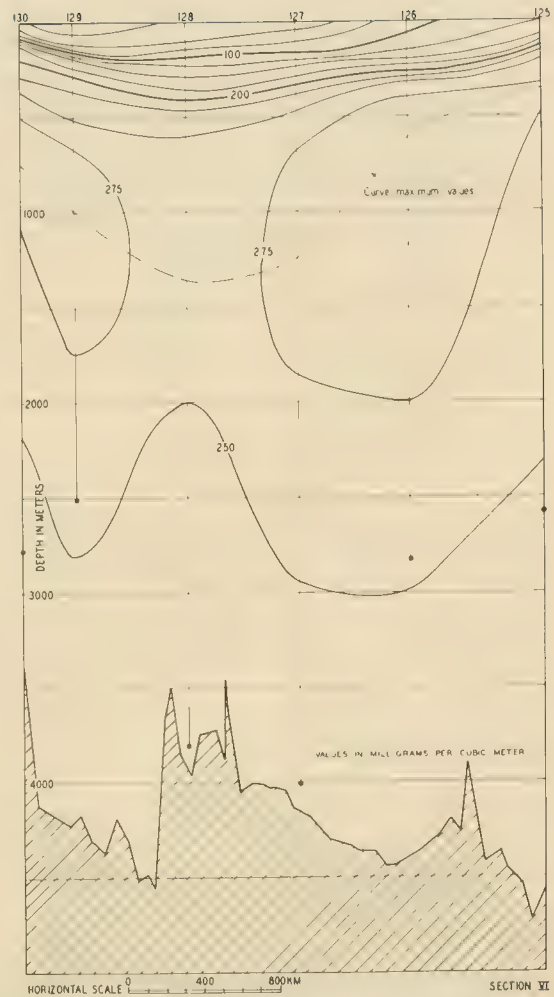


FIG. 131—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN,
FROM CARNEGIE RESULTS, JULY 9 TO SEPTEMBER 4, 1929

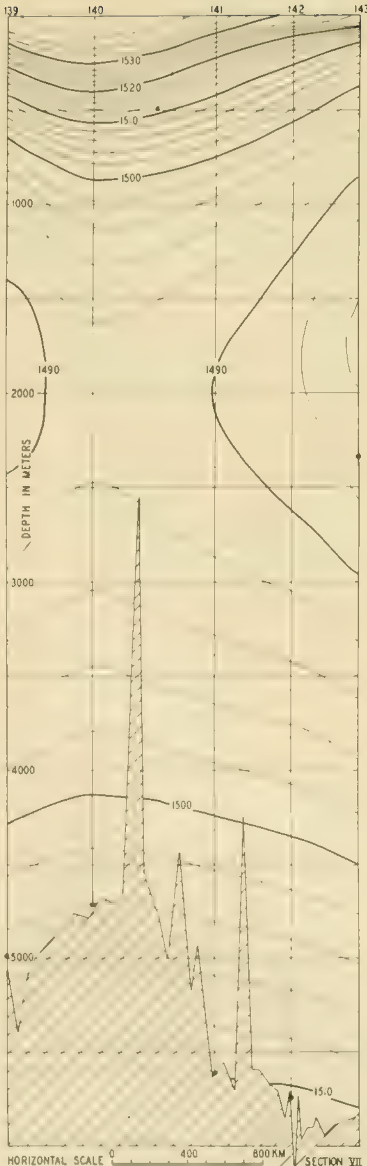


FIG. 32—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 9, 1929

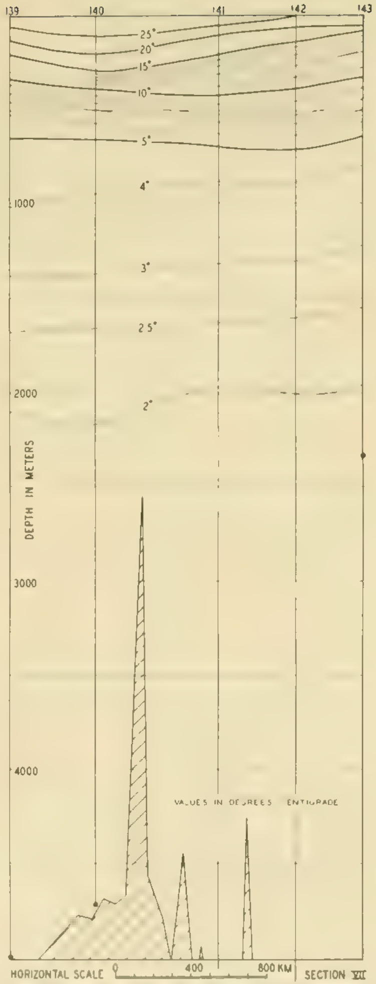


FIG. 33—VERTICAL DISTRIBUTION TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 9, 1929

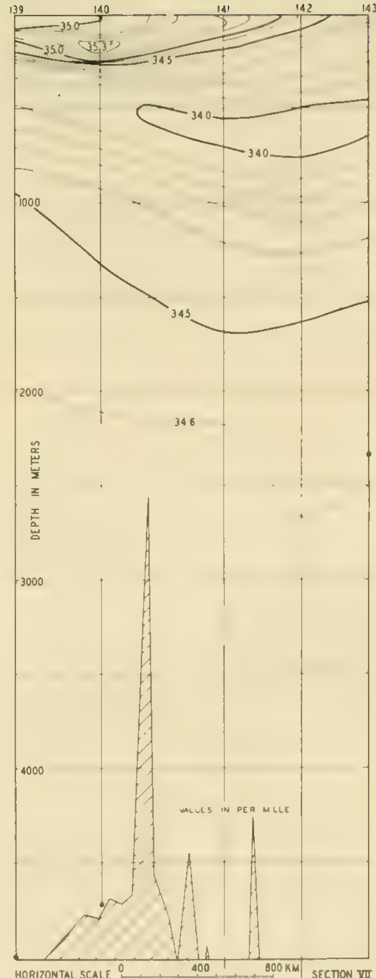


FIG. 34—VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 9, 1929

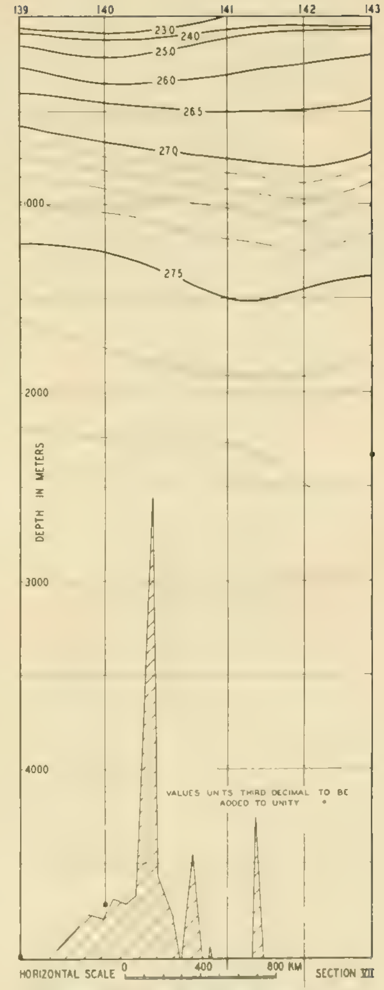


FIG. 35—VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 9, 1929

FIG 136—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 9, 1929

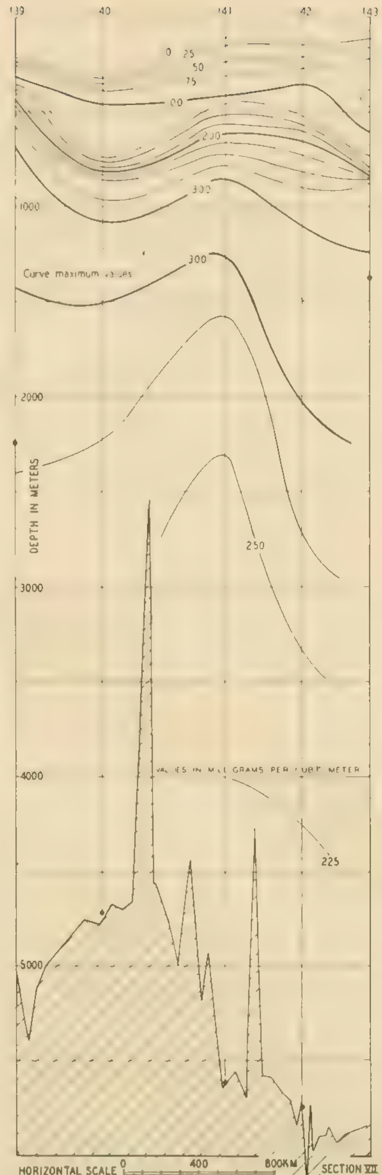


FIG 137—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 9, 1929

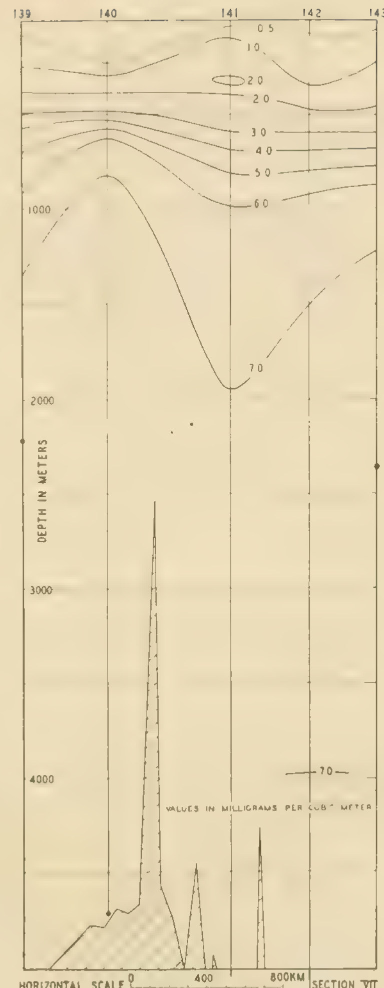


FIG 138—VERTICAL DISTRIBUTION SILICA, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 9, 1929

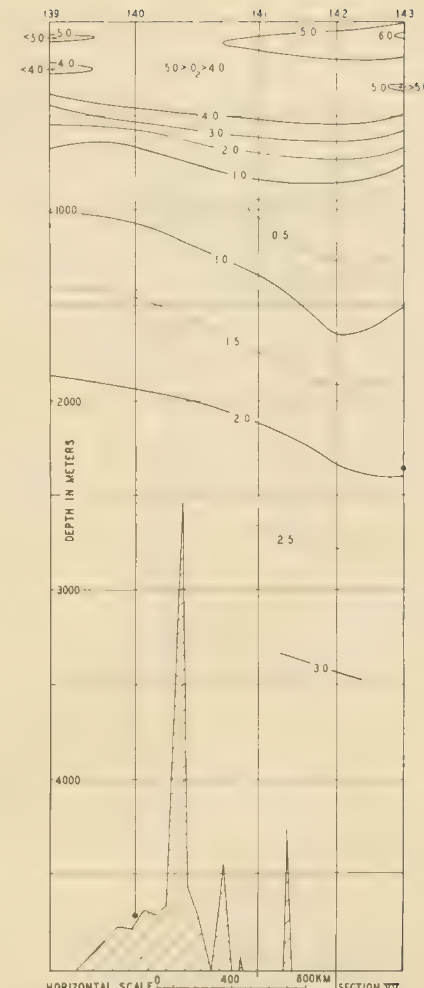


FIG 139—VERTICAL DISTRIBUTION OXYGEN IN MILLILITERS PER LITER, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 22 TO OCTOBER 9, 1929

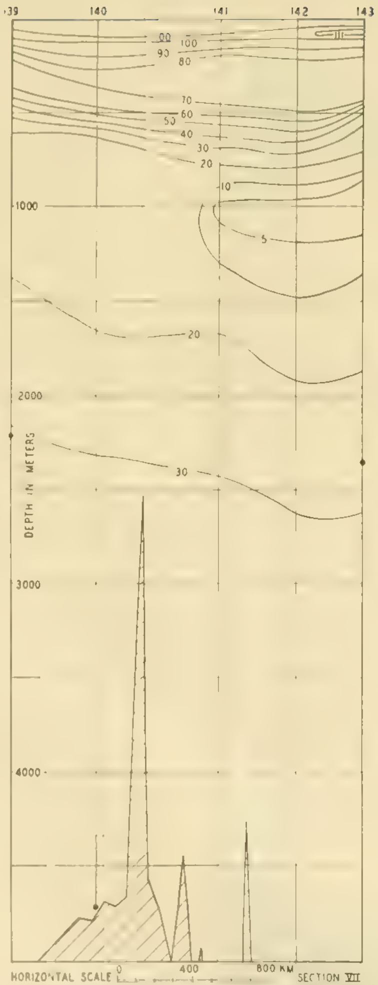
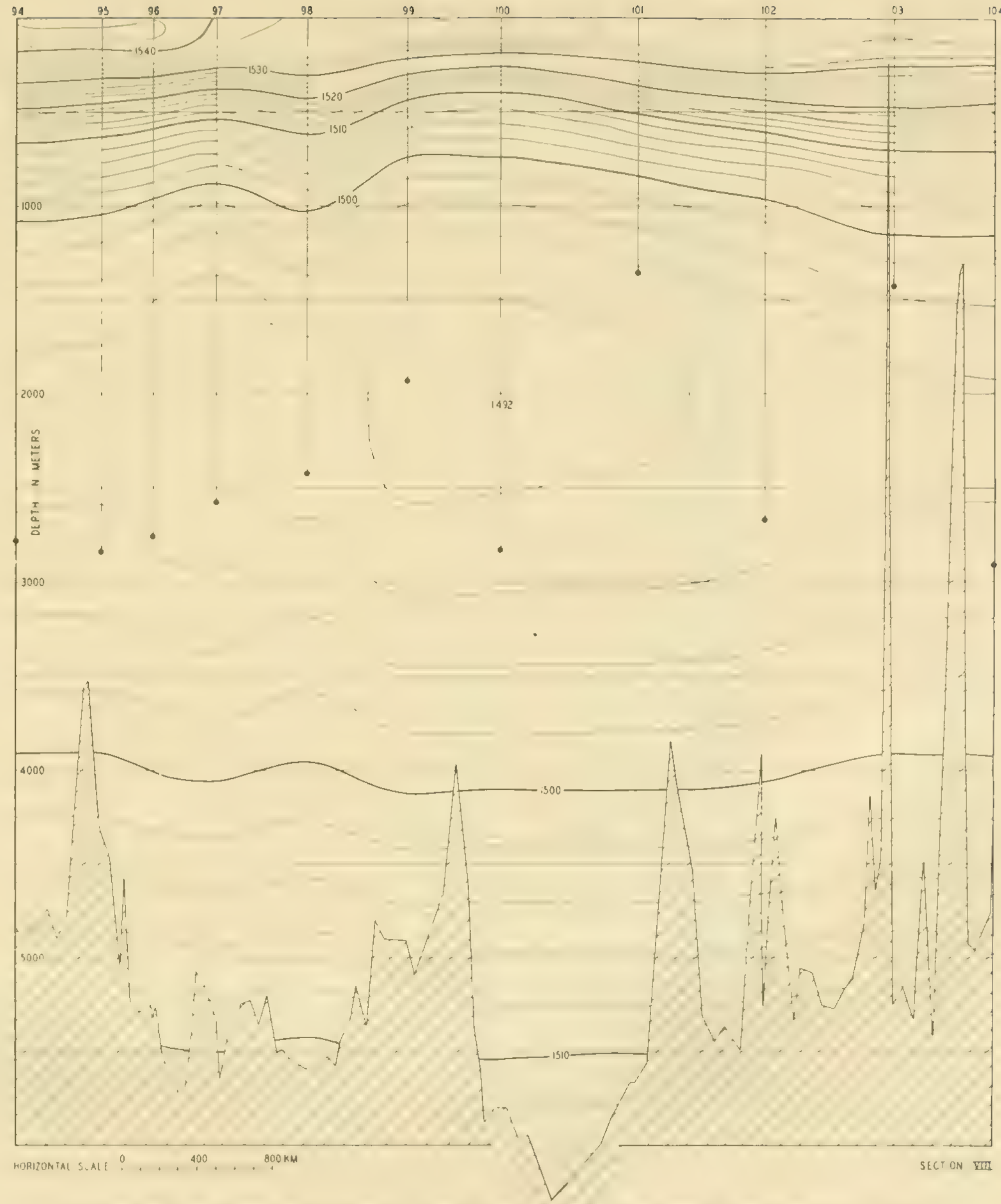


FIG. 140 -VERTICAL DISTRIBUTION [illegible]
IN PER CENT, PA[illegible]
RESULTS, SEPTEM[illegible]



[illegible] VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, [illegible]

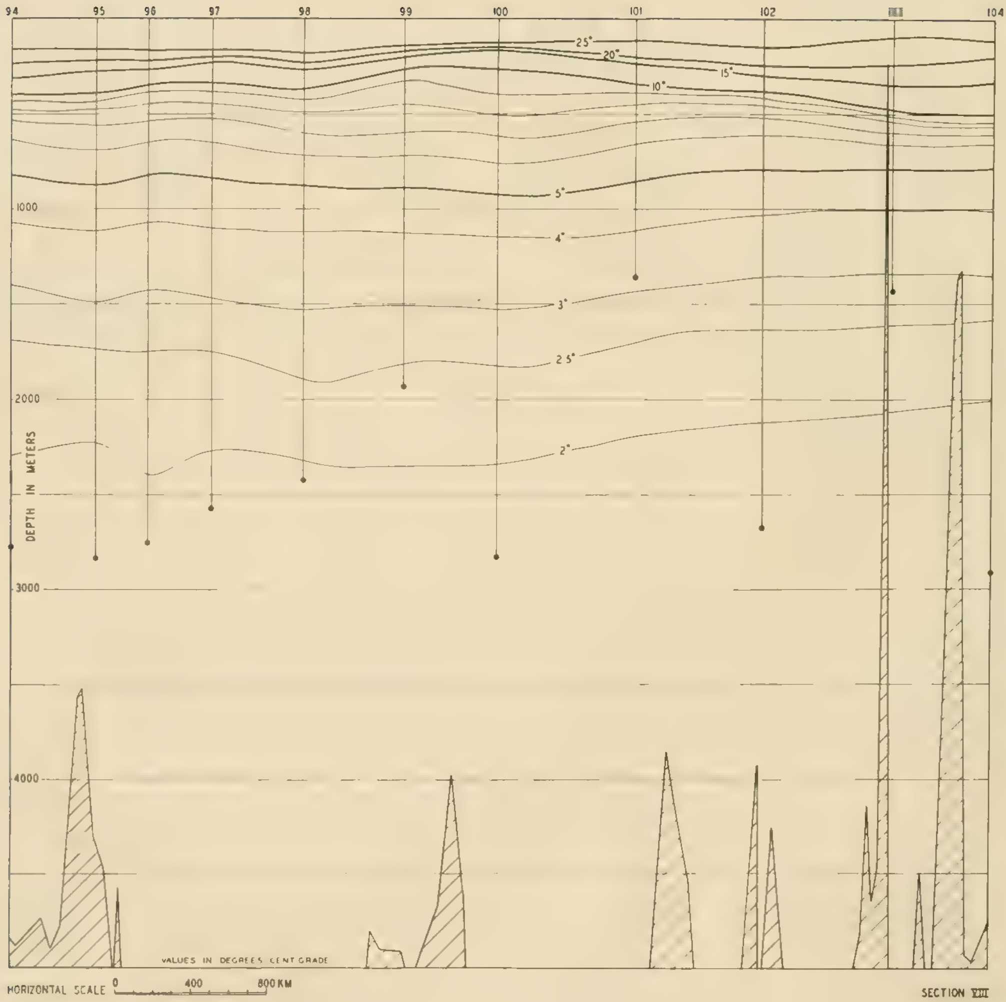


FIG 142—VERTICAL DISTRIBUTION TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, APRIL 22 TO MAY 13, 1929

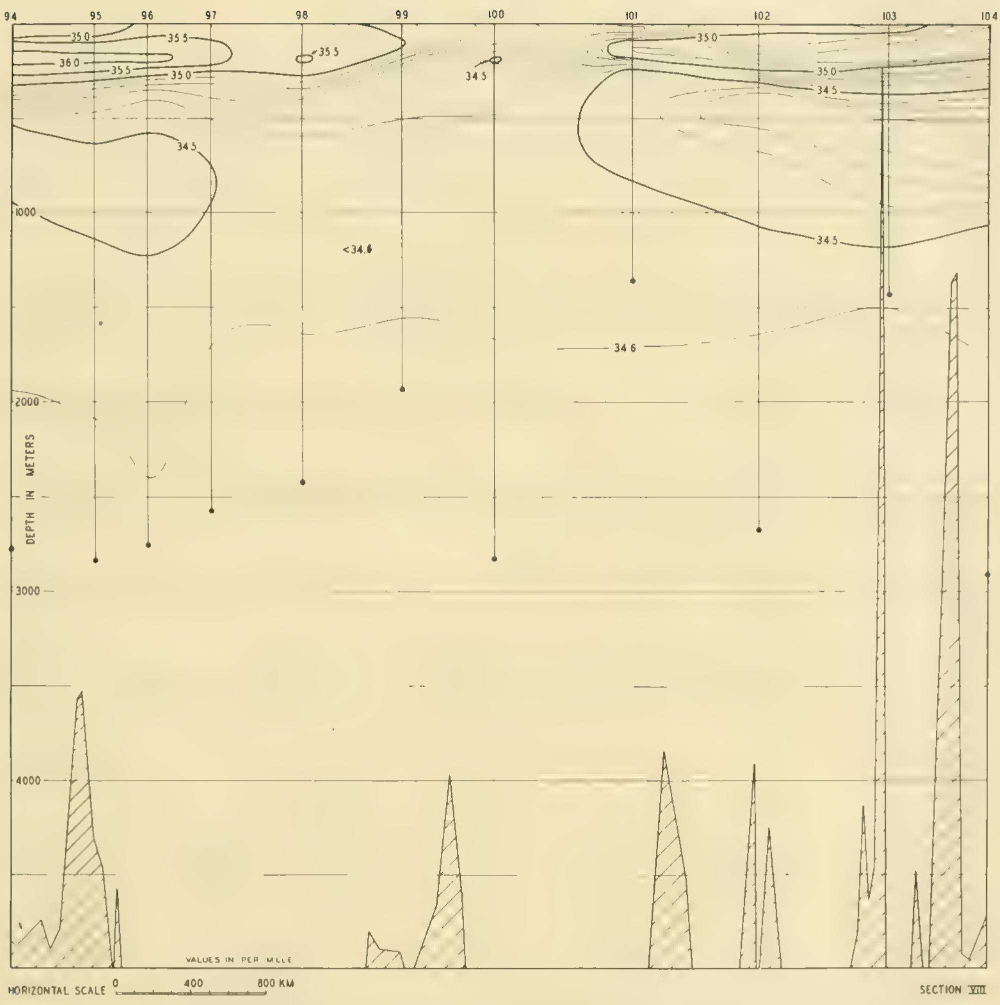


FIG 143 VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, APRIL 22 TO MAY 13, 1929

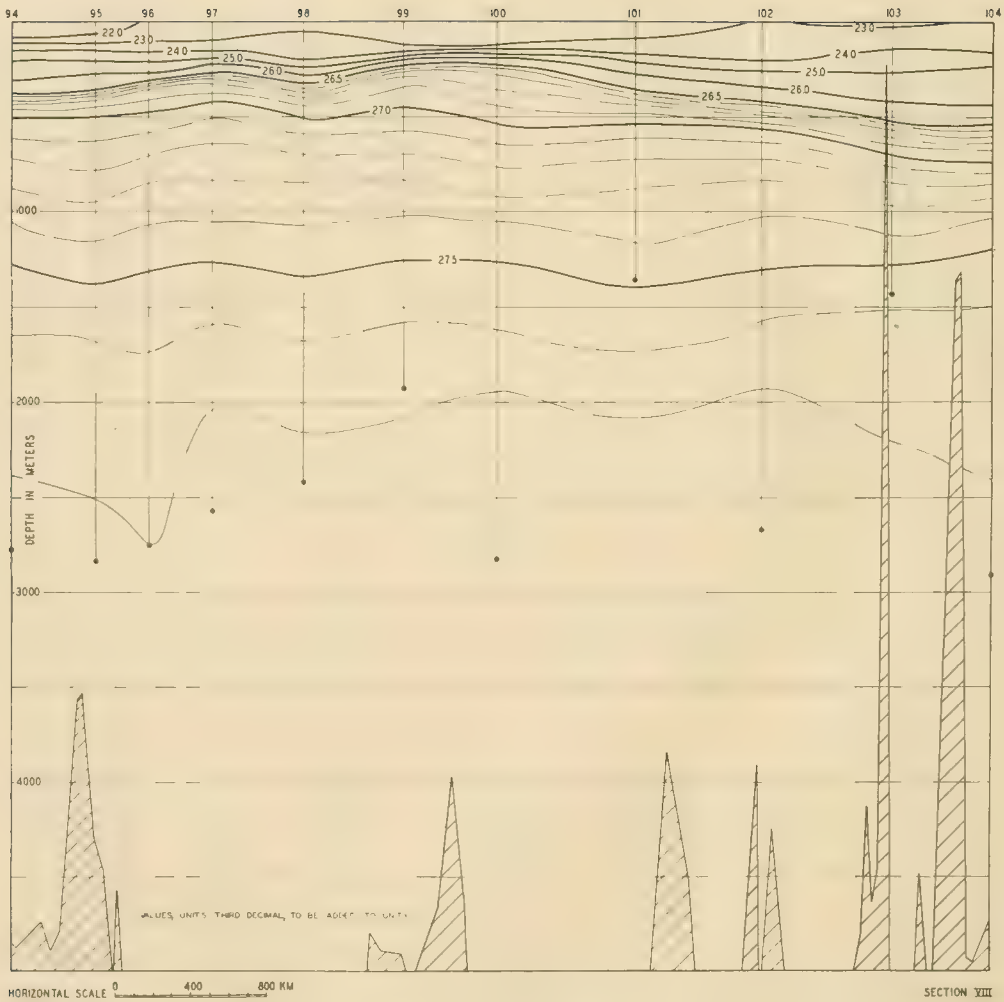


FIG 144—VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, APRIL 22 TO MAY 13, 1929

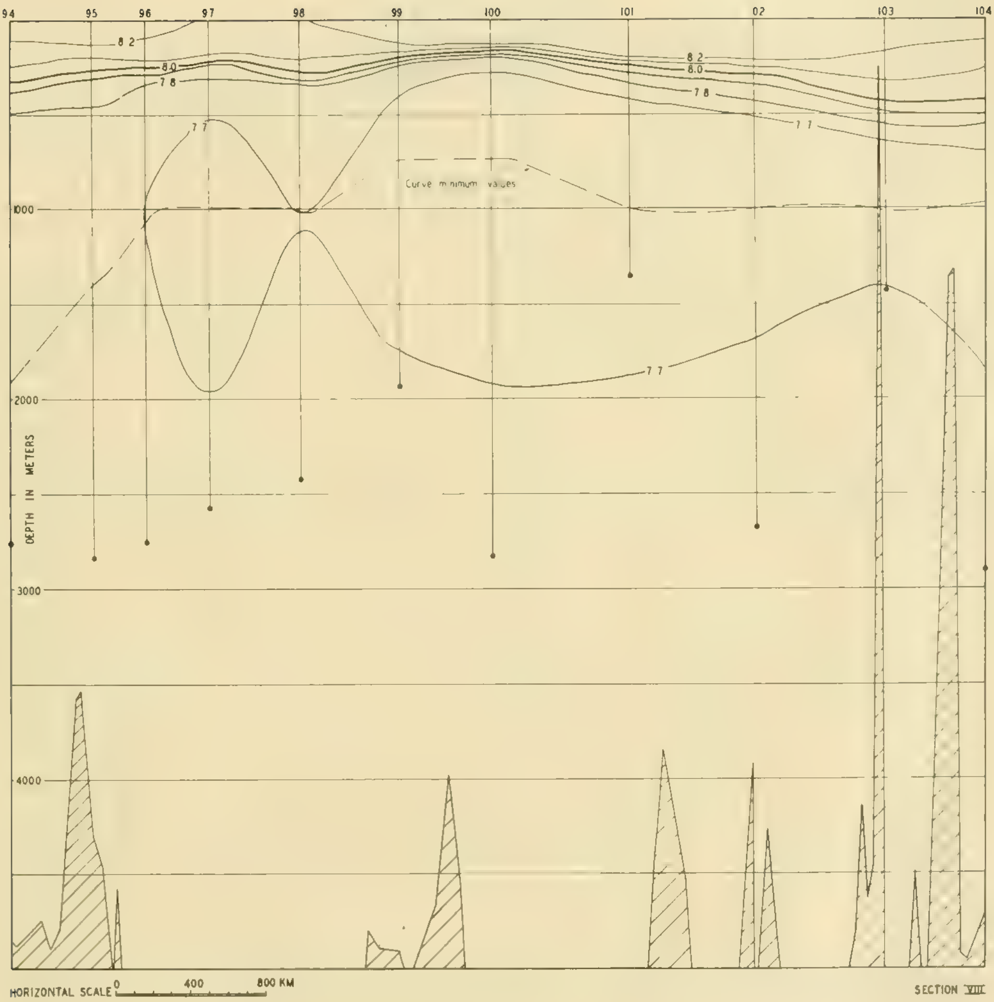


FIG 145—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, APRIL 22 TO MAY 13, 1929

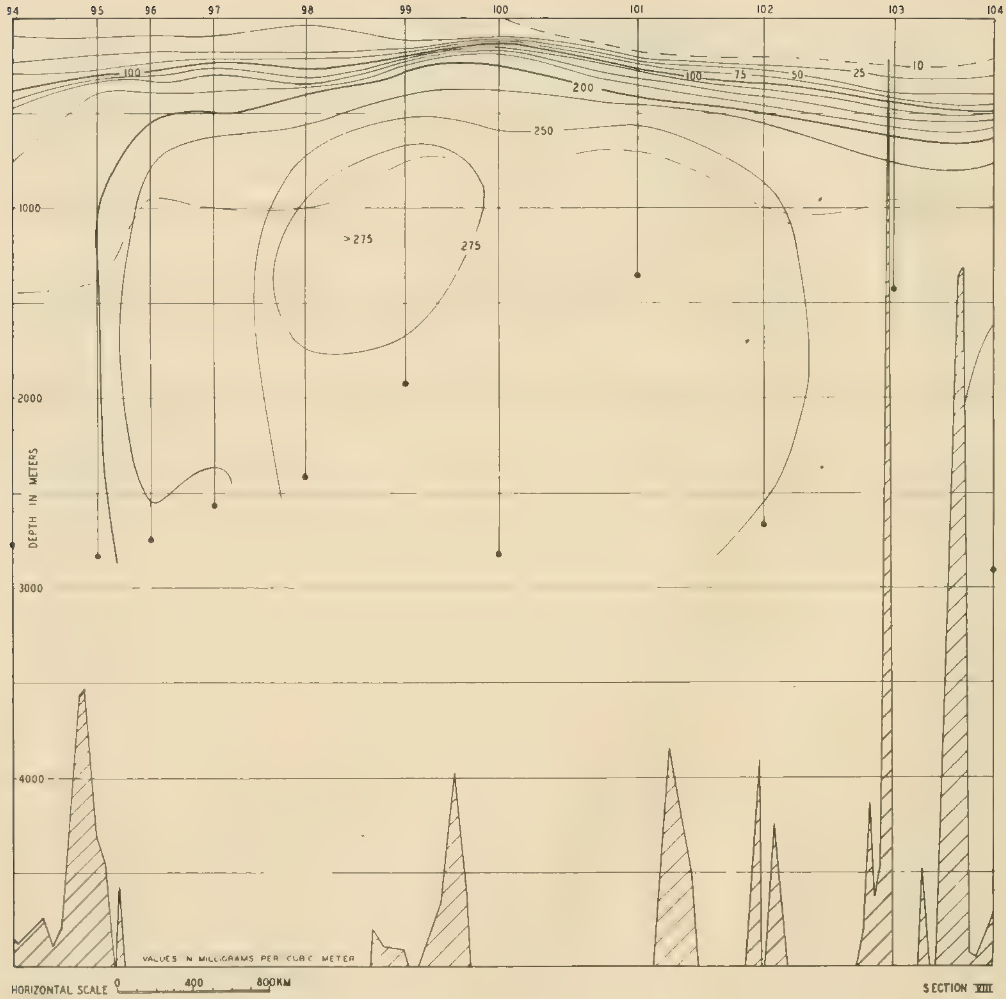


FIG. 146—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, APRIL 22 TO MAY 13, 1929

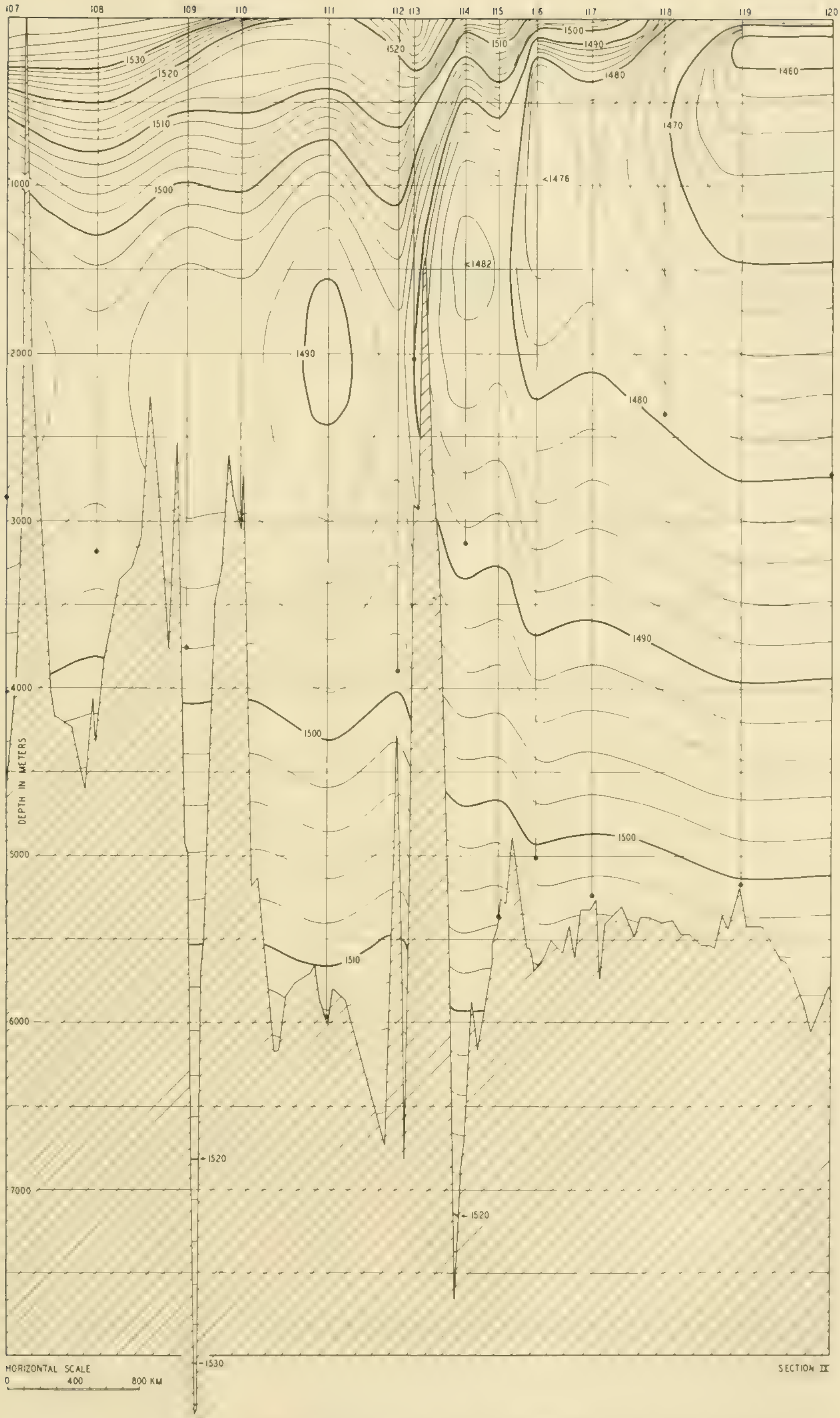


FIG. 47—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, MAY 10 TO JULY 9, 1929

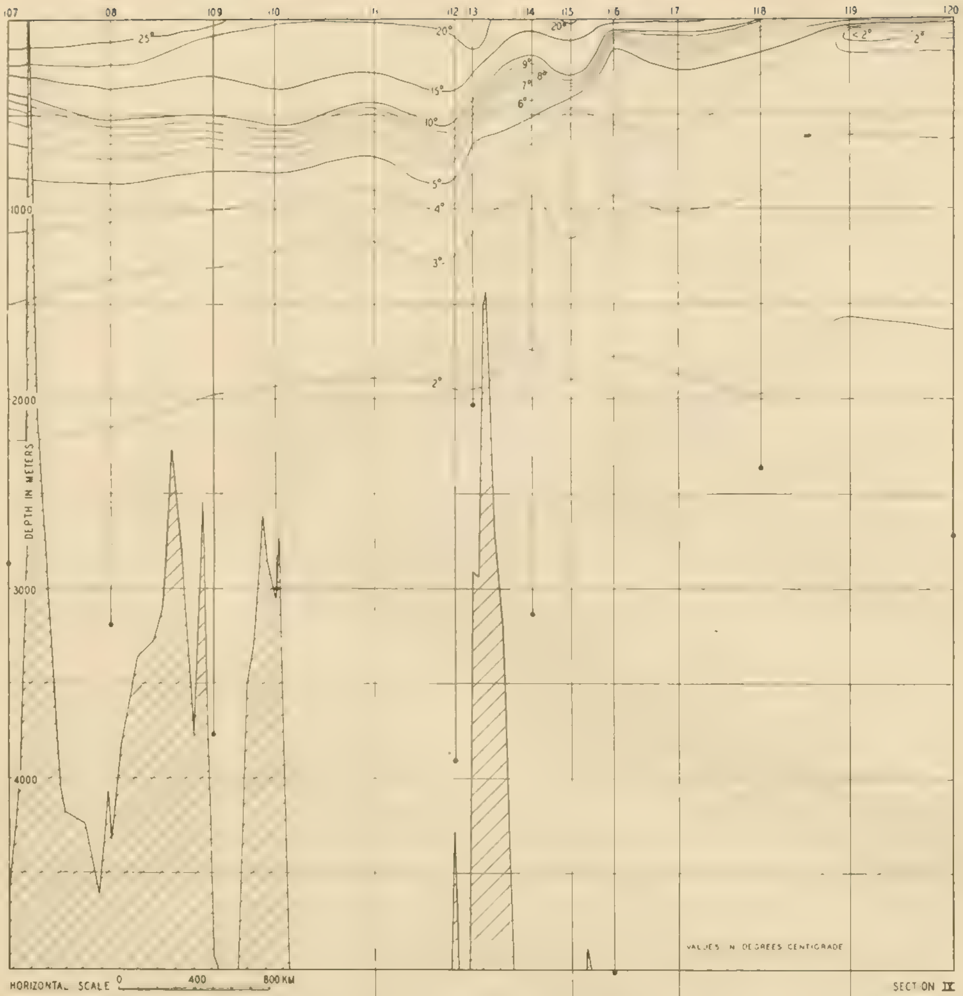


FIG. 148—VERTICAL DISTRIBUTION TEMPERATURE PACIFIC OCEAN, FROM CARNEGIE RESULTS MAY 9 TO JULY 9 1929

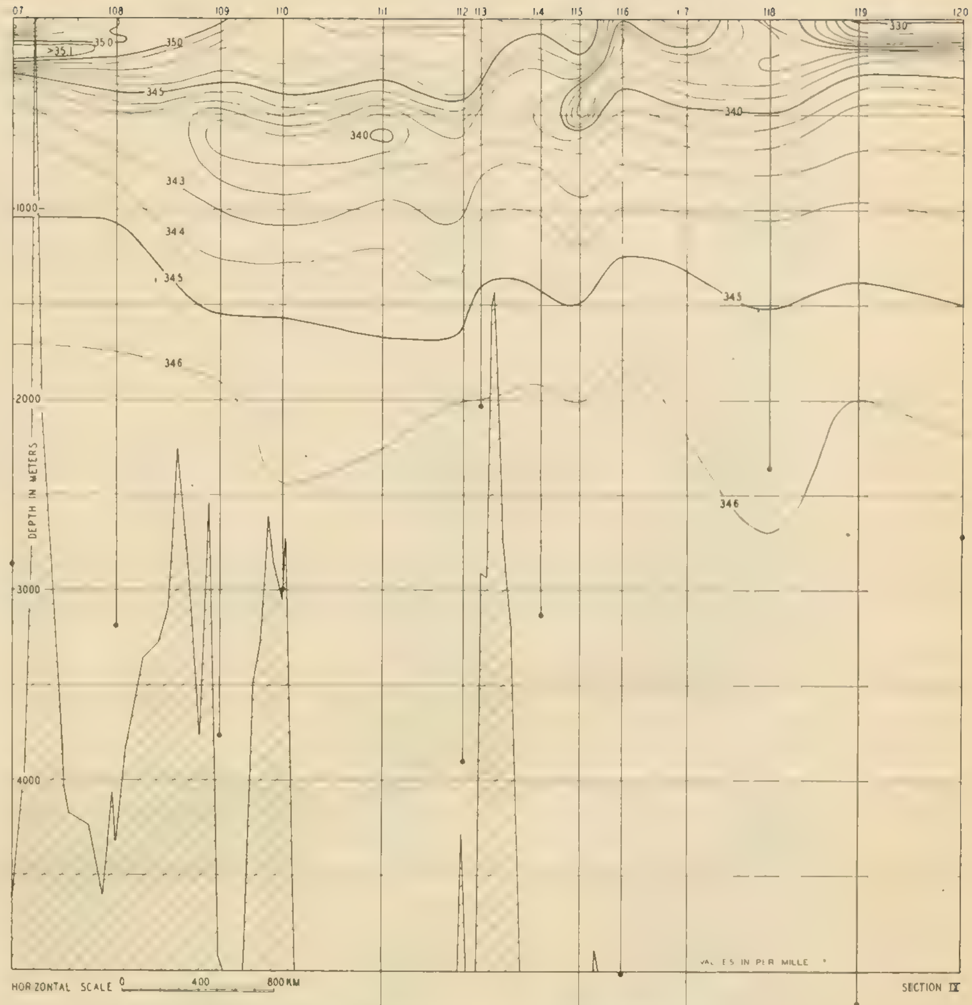


FIG. 149—VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN FROM CARNEGIE RESULTS MAY 19 TO JULY 9, 1929

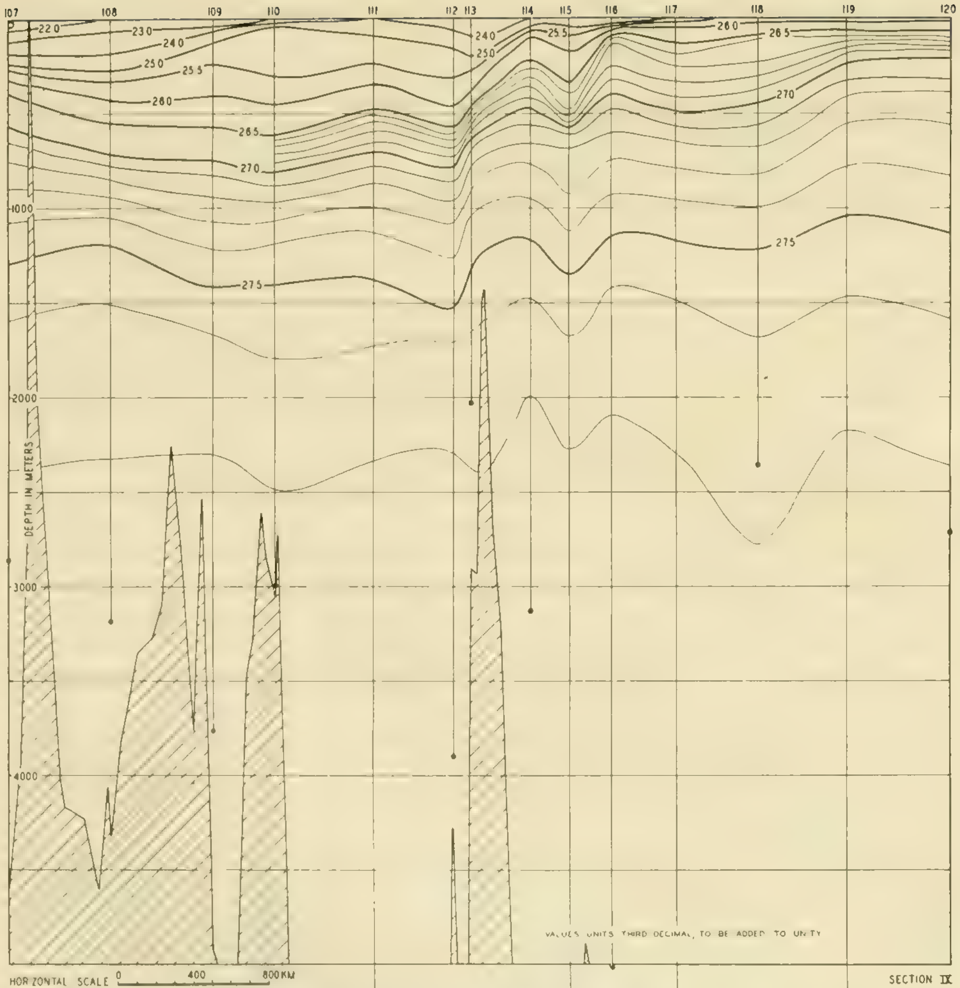


FIG. 50—VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS MAY 19 TO JULY 9, 1929

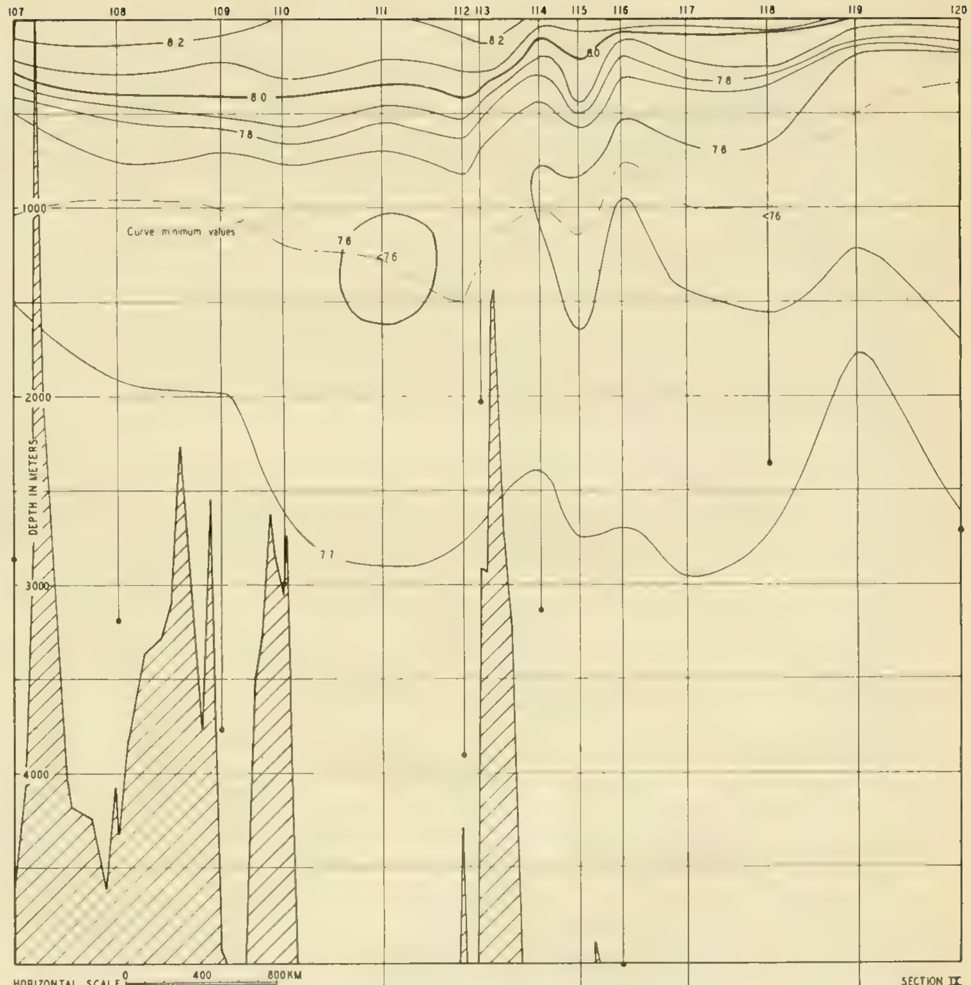


FIG. 51—VERTICAL DISTRIBUTION HYDROGEN ION PACIFIC OCEAN, FROM CARNEGIE RESULTS, MAY 19 TO JULY 9, 1929

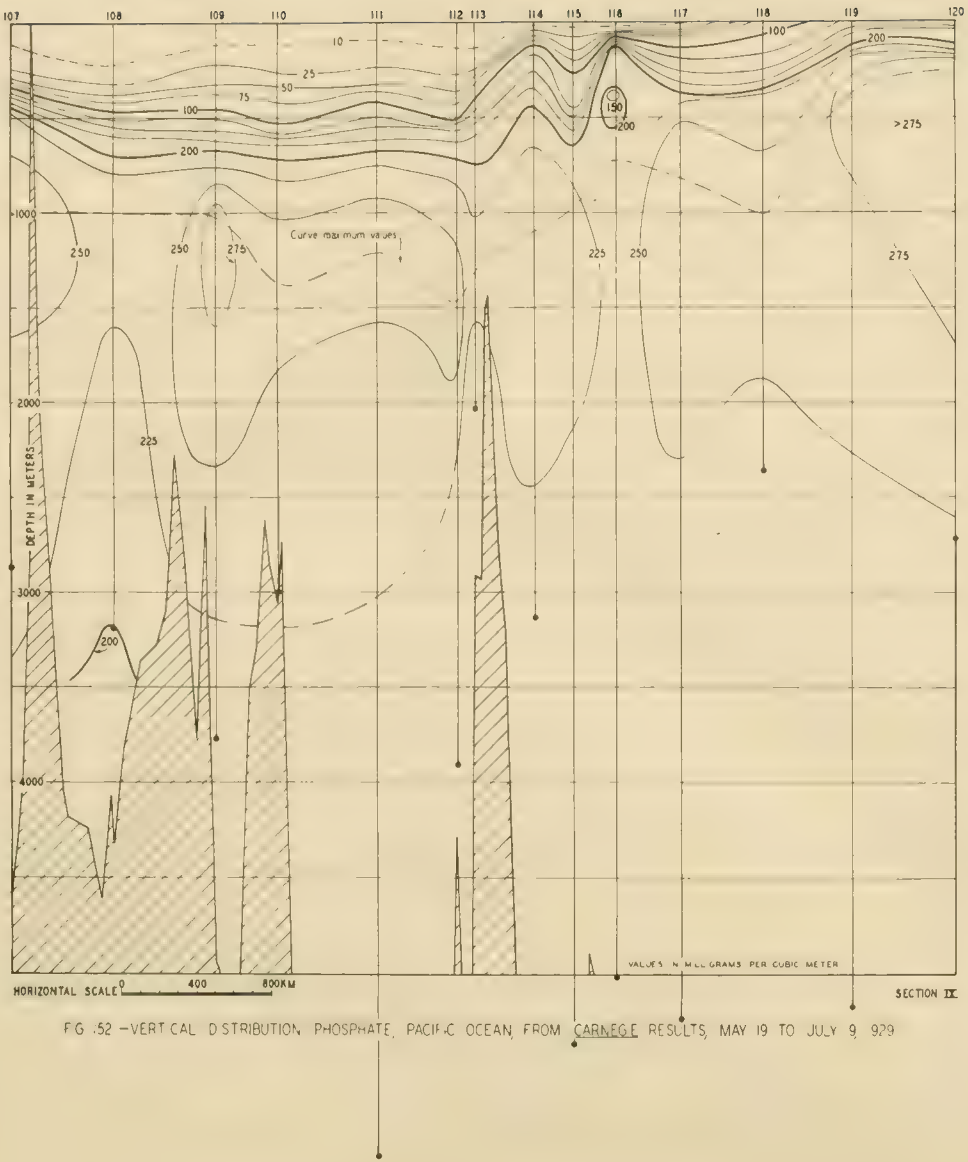


FIG. 152.—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, MAY 19 TO JULY 9, 1929

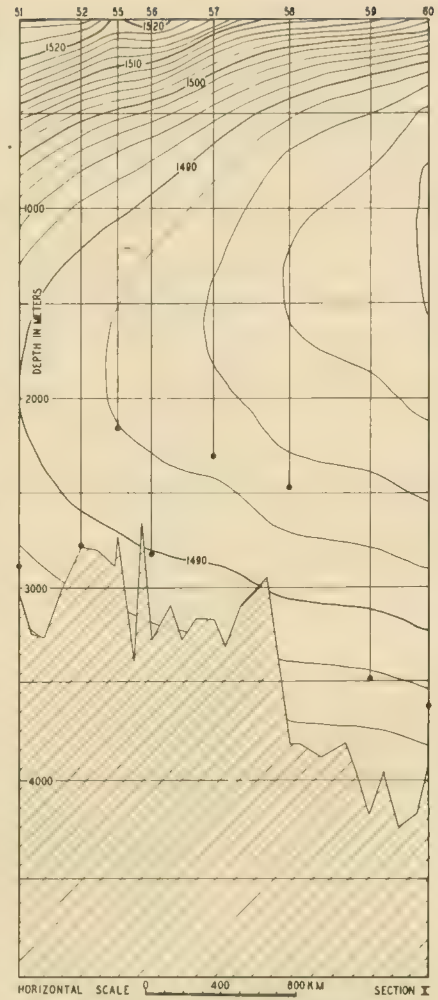


FIG. 153.—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, DECEMBER 1-3, AND DECEMBER 16-26, 1928

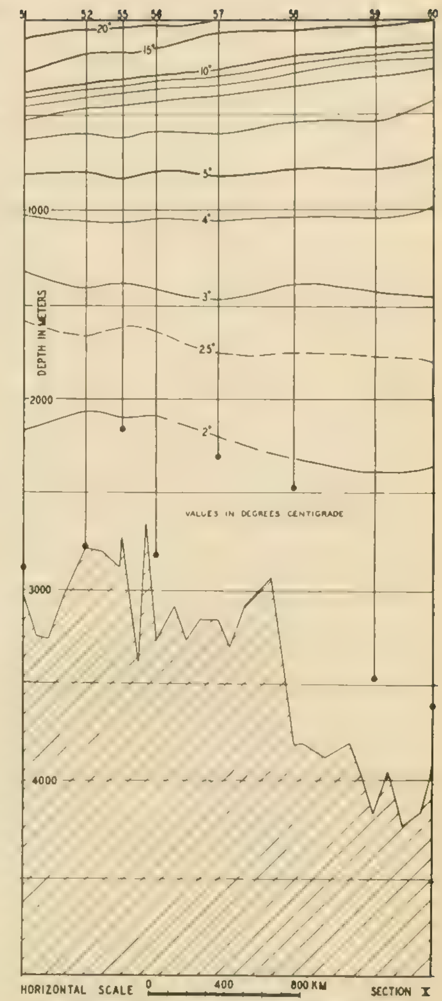


FIG. 154.—VERTICAL DISTRIBUTION TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, DECEMBER 1-3, AND DECEMBER 16-26, 1928

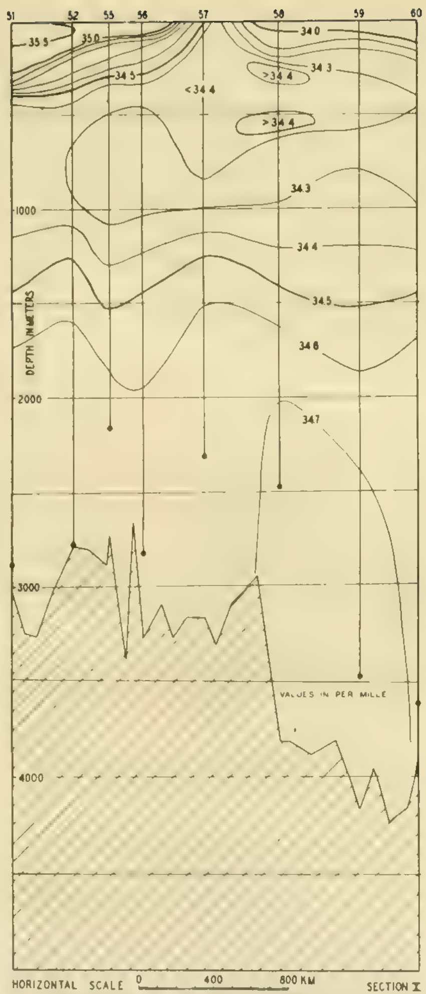


FIG. 155. VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, DECEMBER 1-3, AND DECEMBER 16-26, 1928

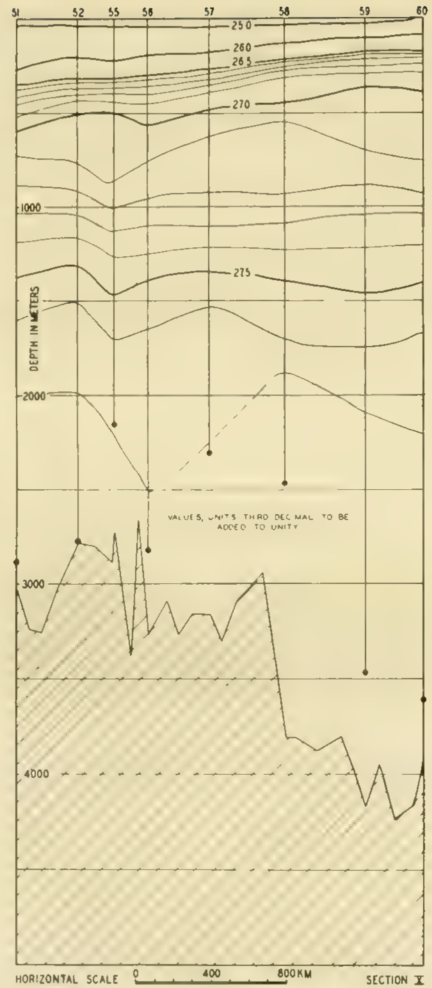


FIG. 156. VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, DECEMBER 1-3, AND DECEMBER 16-26, 1928

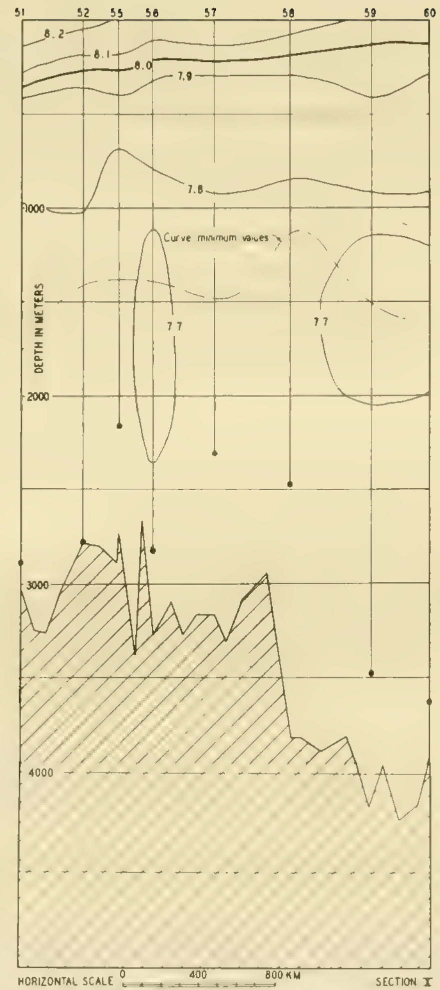


FIG. 157. VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, DECEMBER 1-3 AND DECEMBER 16-26, 1928

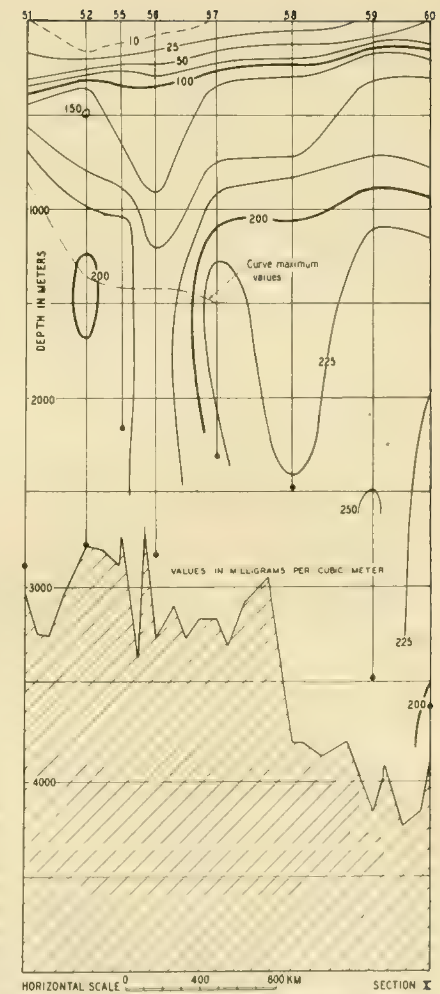


FIG. 158. VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, DECEMBER 1-3 AND DECEMBER 16-26, 1928

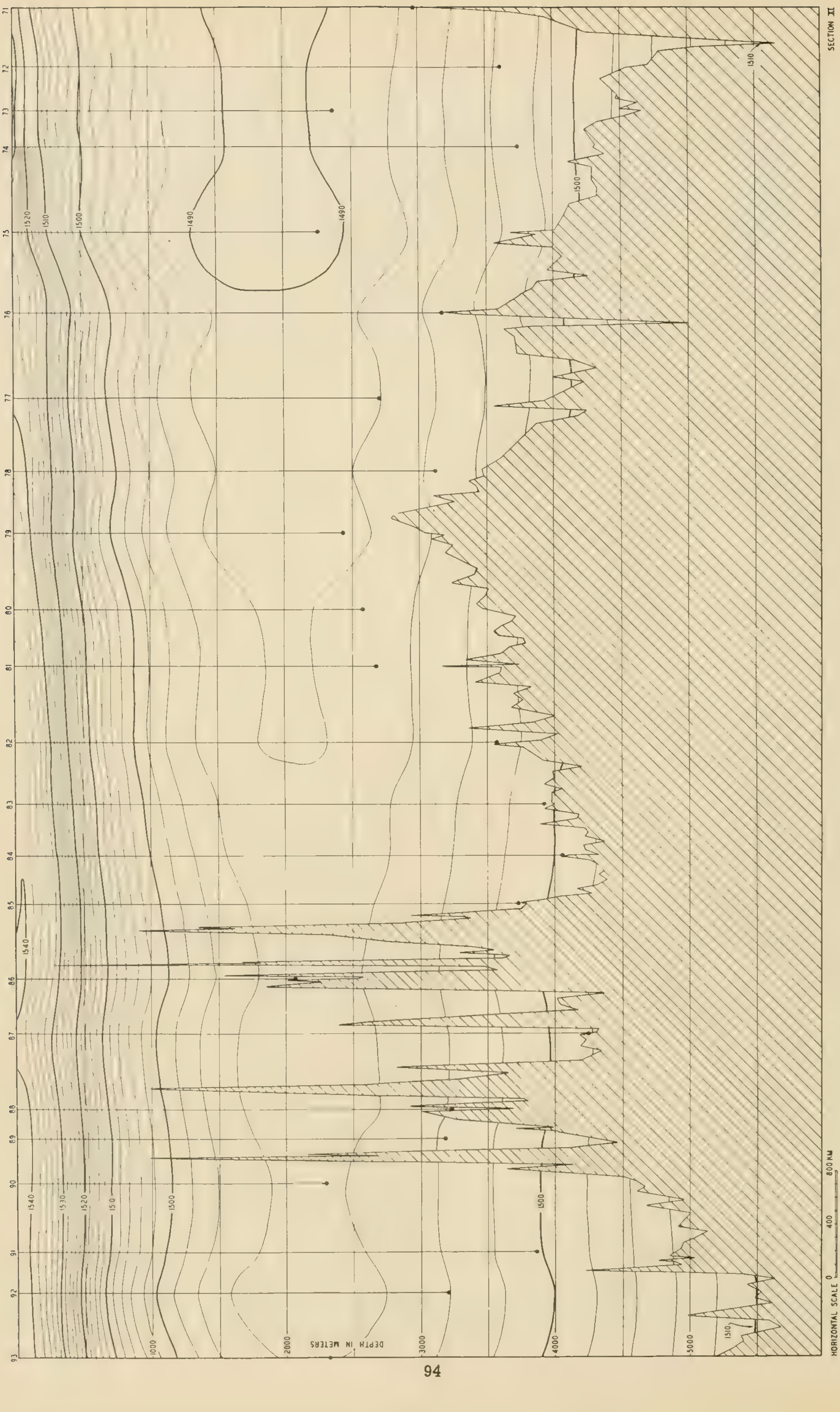


FIG. 159—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, FEBRUARY 6 TO MARCH 31, 1929

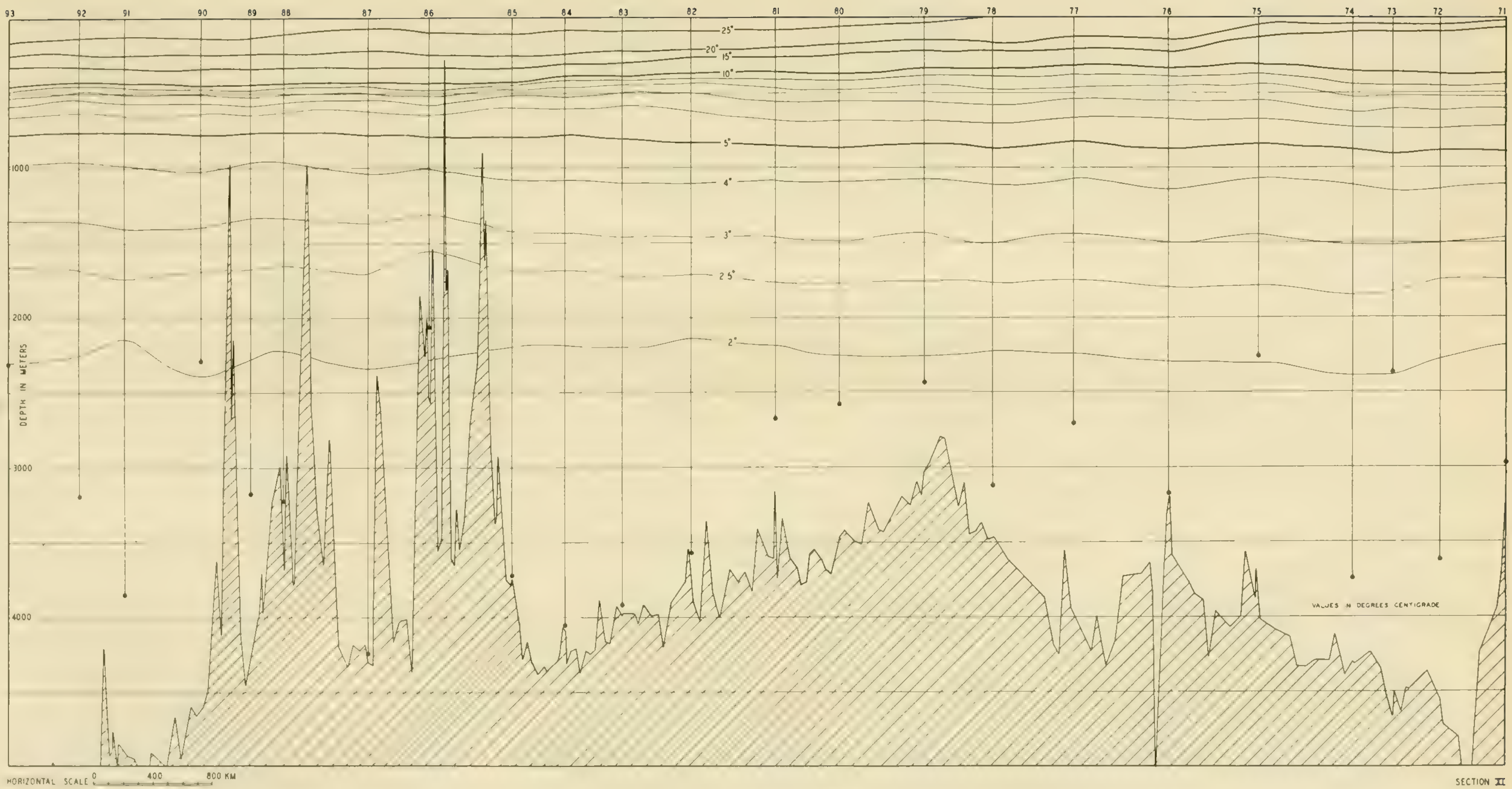


FIG 60 VERTICAL DISTRIBUTION TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, FEBRUARY 6 TO MARCH 31, 1929

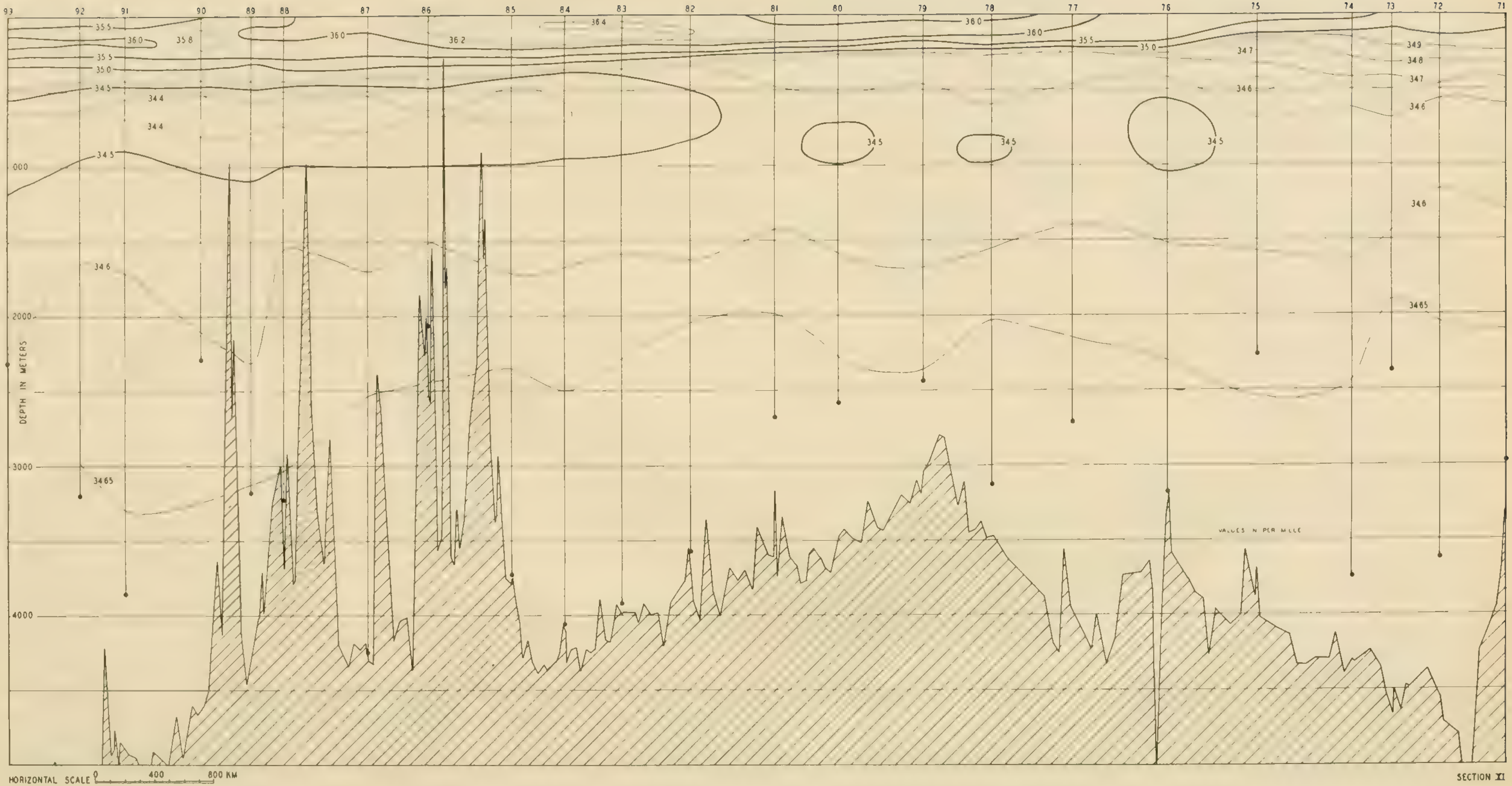


FIG. 61—VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, FEBRUARY 6 TO MARCH 31, 1929

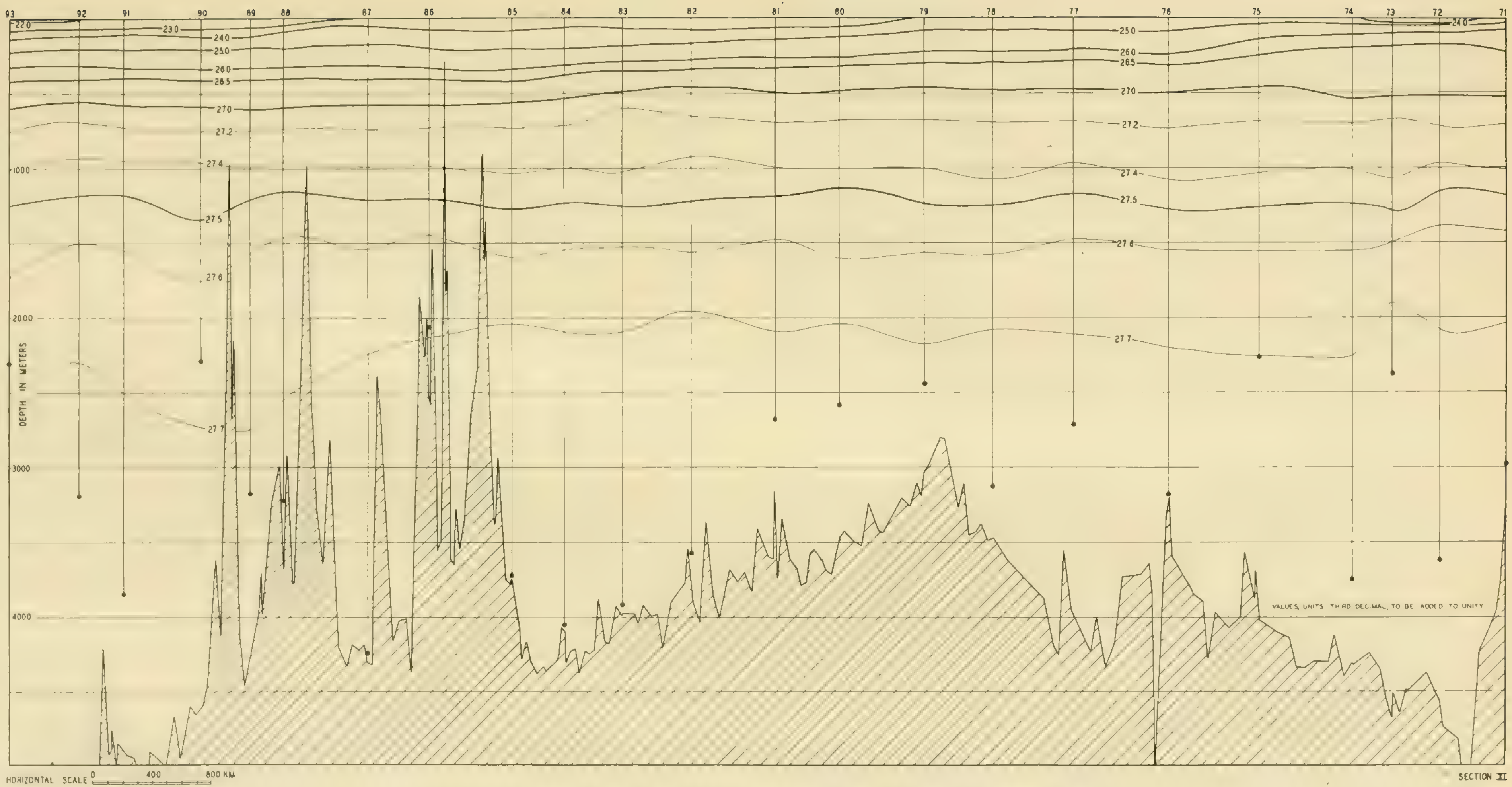


FIG 162-VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, FEBRUARY 6 TO MARCH 31, 1929

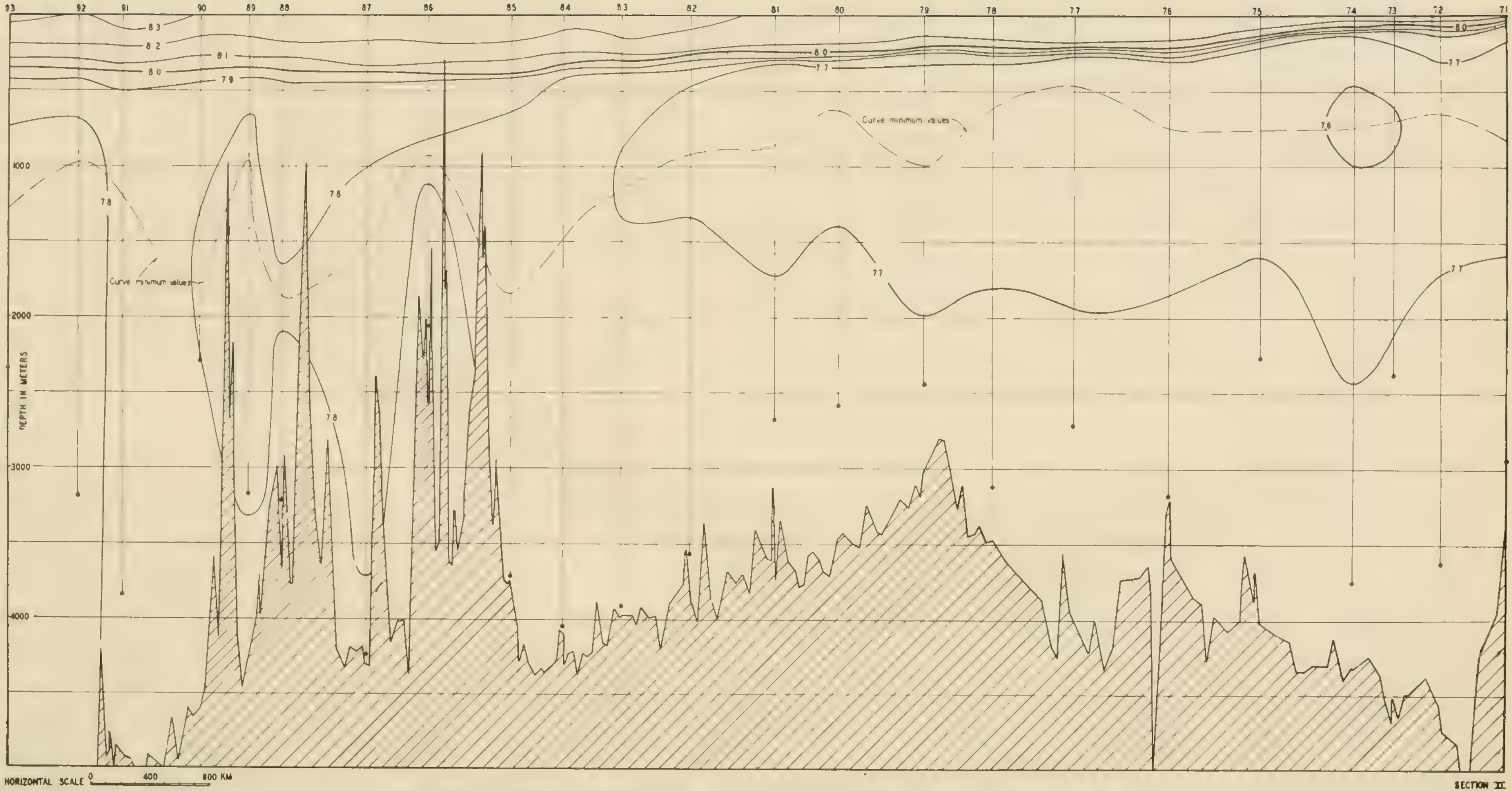


FIG. 163—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, FEBRUARY 6 TO MARCH 31, 1929

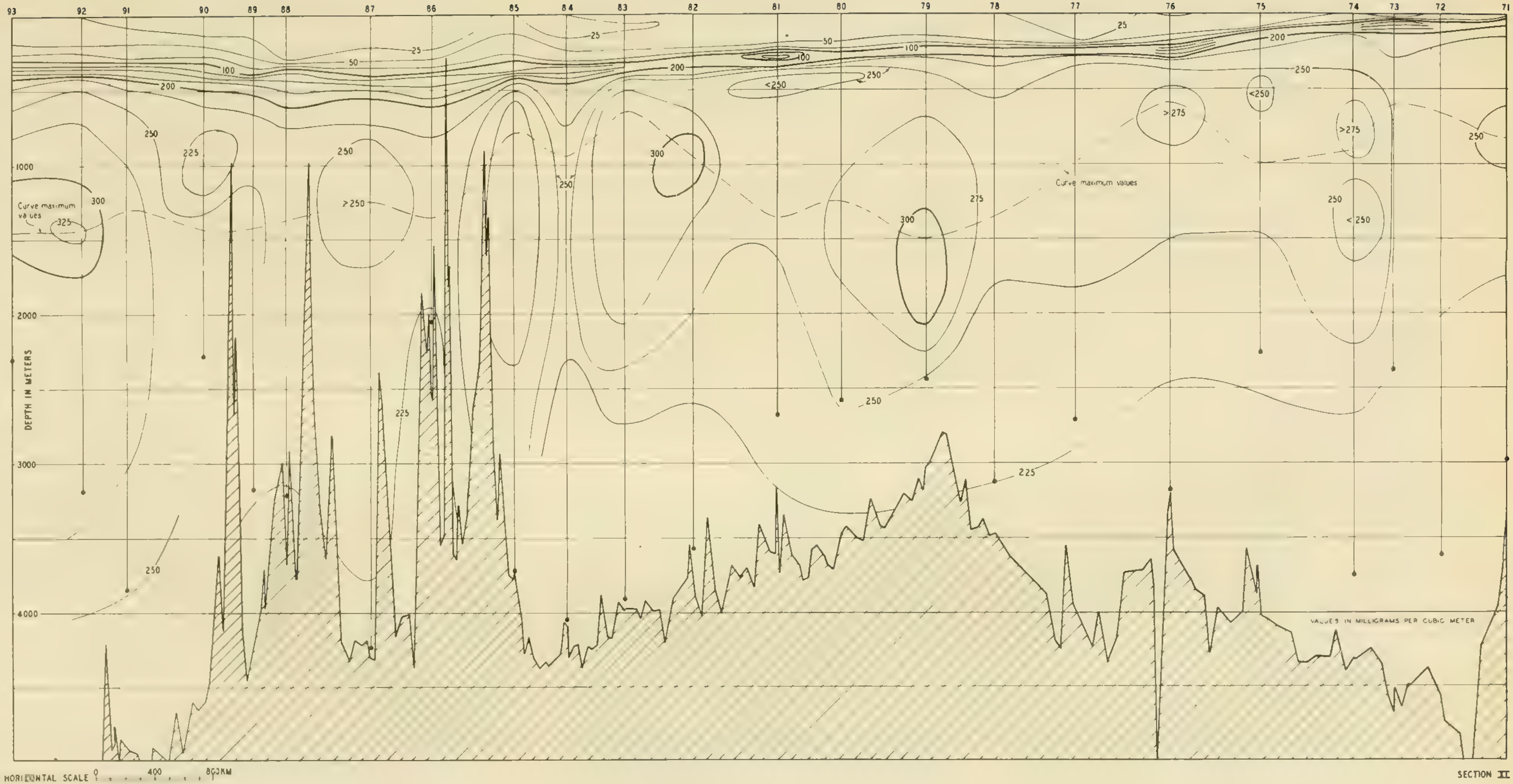


FIG. 164—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, FEBRUARY 6 TO MARCH 31, 1929

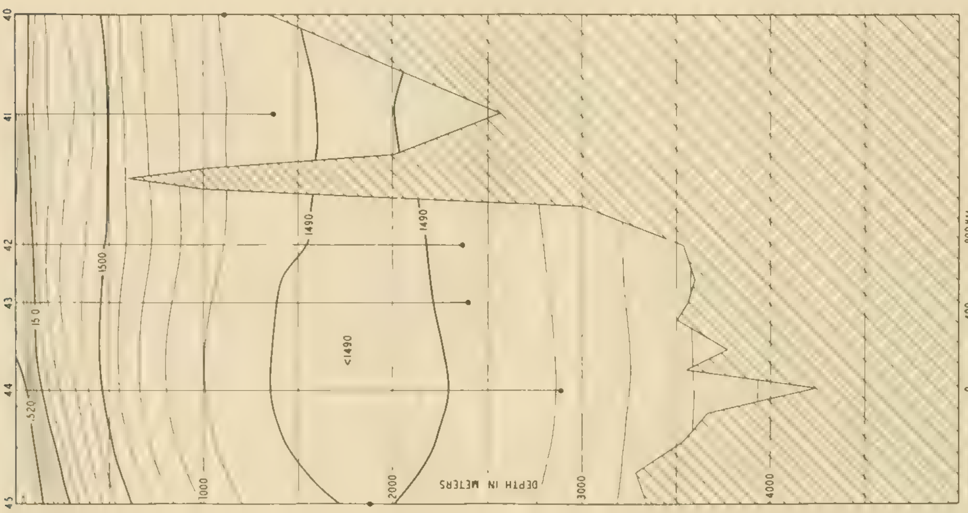


FIG 65—VERTICAL DISTRIBUTION, SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 8-19, 1929

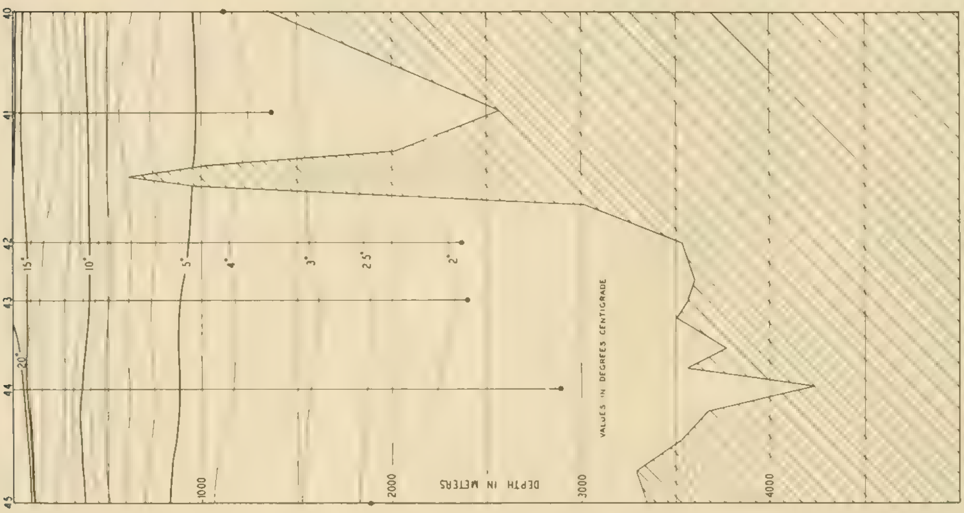


FIG 66 VERTICAL DISTRIBUTION TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 8-9, 1929

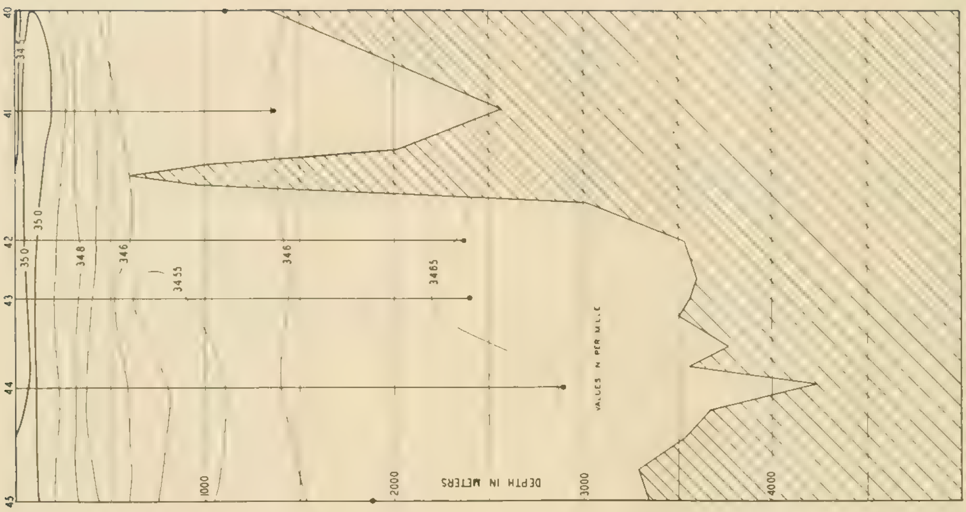


FIG 67- VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 8-9, 1929

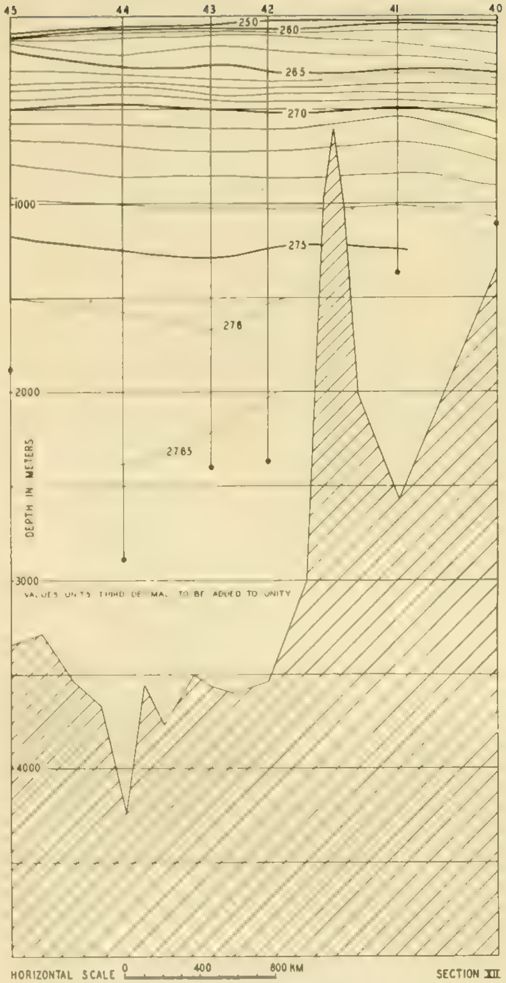


FIG 168—VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 8-19, 1929

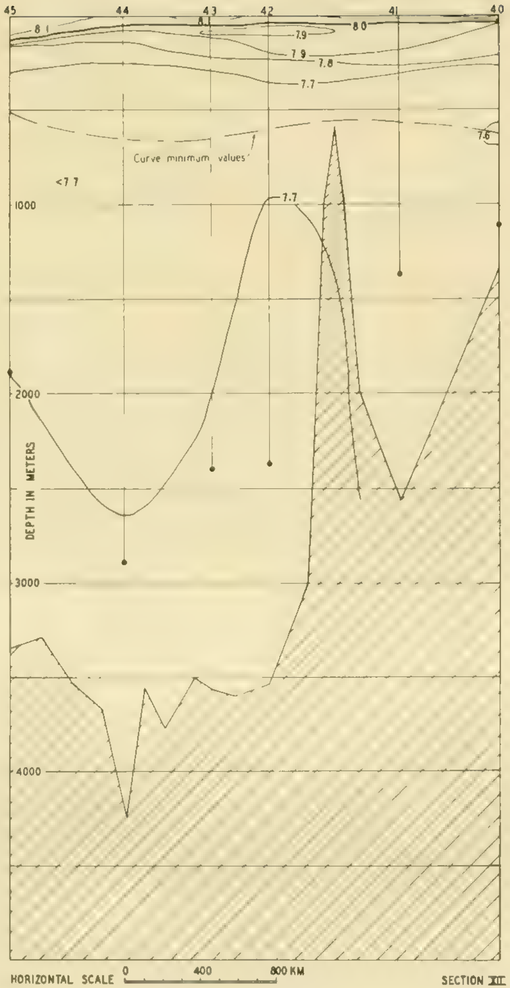


FIG 169—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, NOVEMBER 8-19, 1929

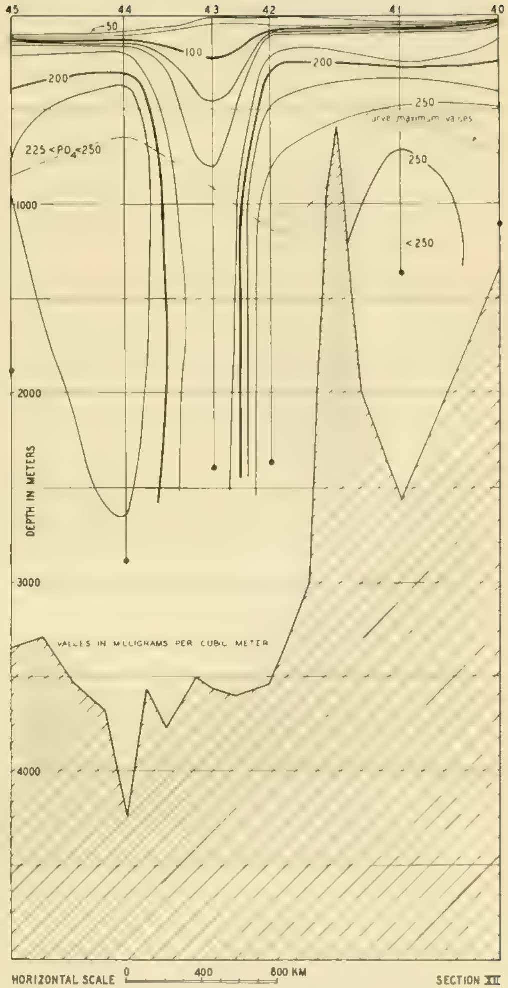


FIG. 170—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN FROM CARNEGIE RESULTS, NOVEMBER 8-19, 1929

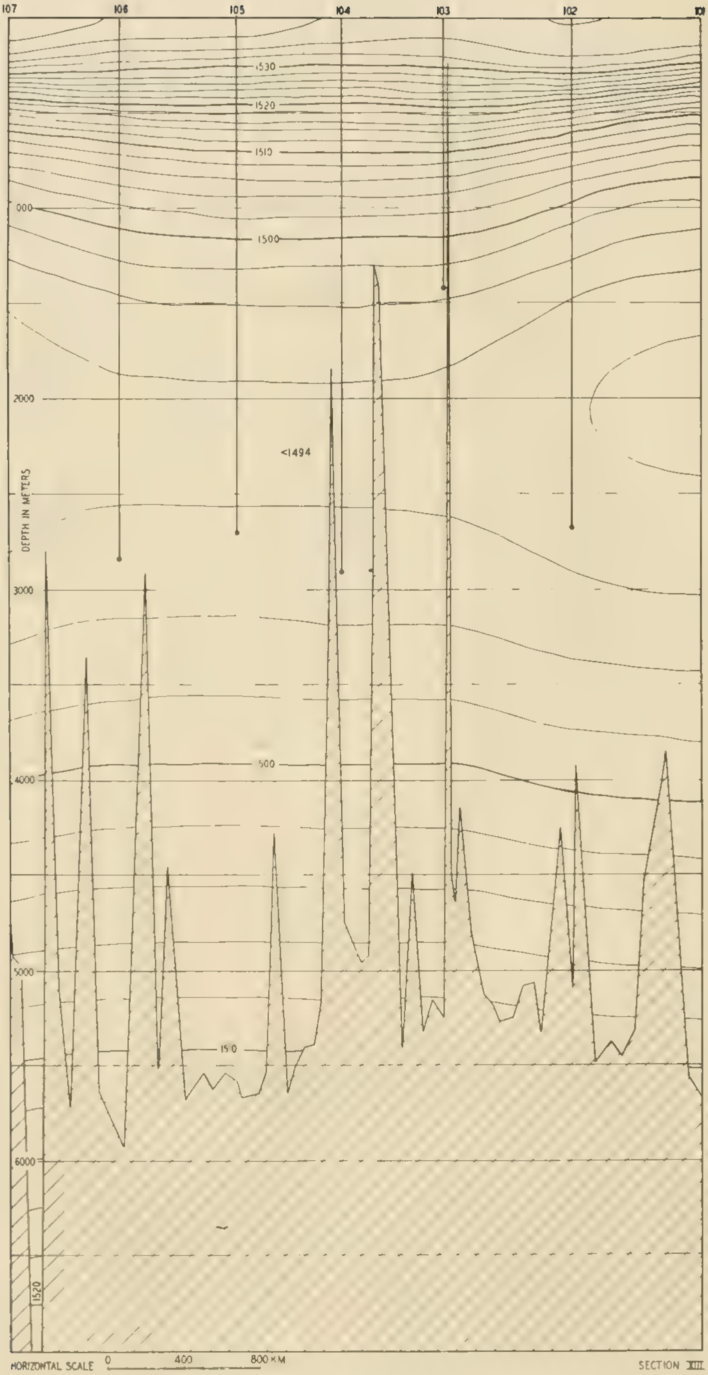


FIG. 171—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, MAY 7-19, 1929

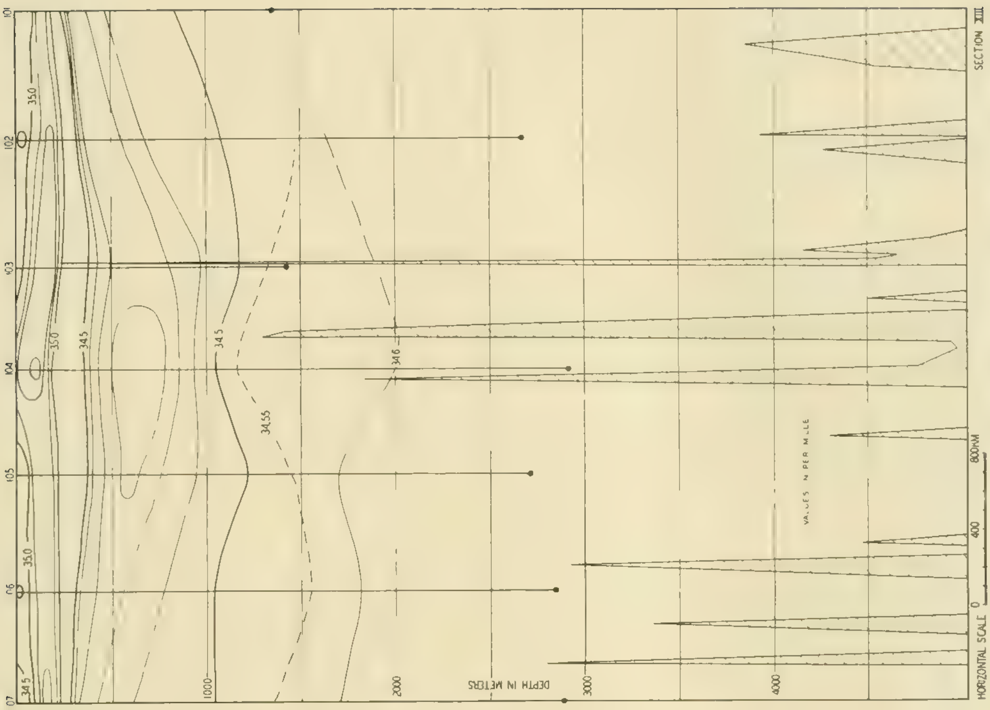


FIG 173 VERTICAL DISTRIBUTION SALINITY PACIFIC OCEAN FROM CARNEGIE RESULTS
MAY 7-19, 1929

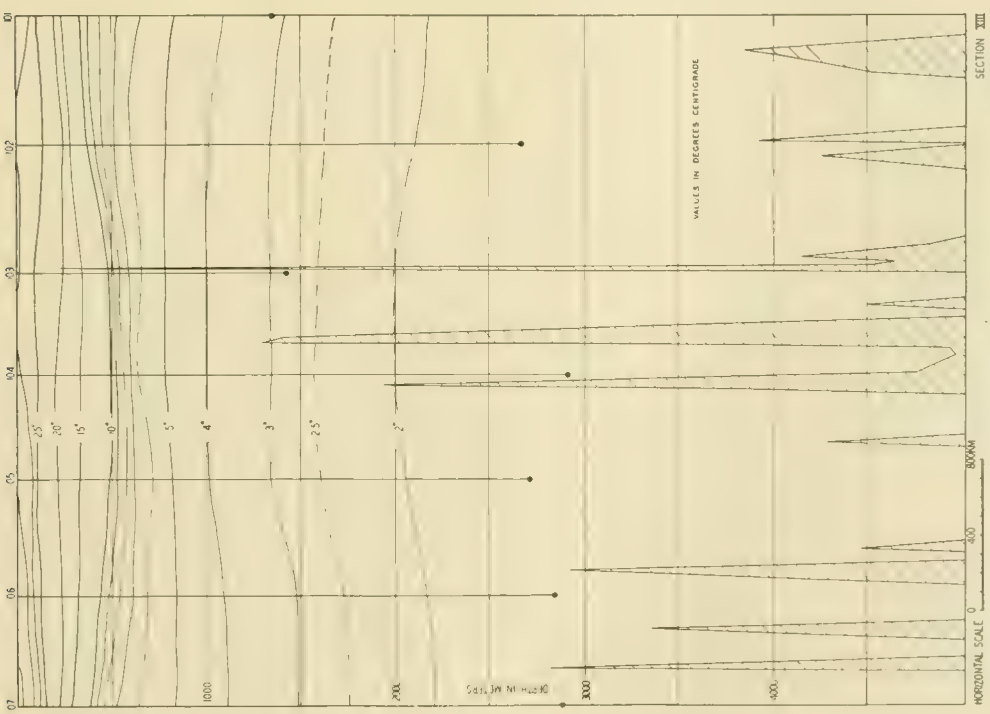


FIG 172 VERTICAL DISTRIBUTION TEMPERATURE PACIFIC OCEAN, FROM CARNEGIE RESULTS,
MAY 7-19, 1929

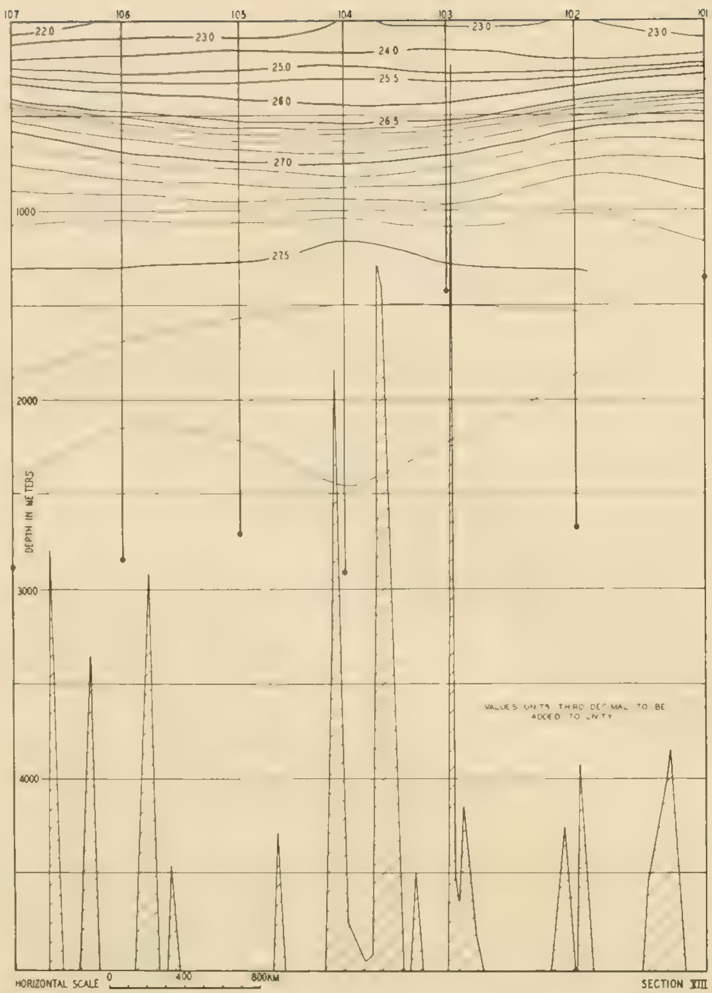


FIG 174—VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, MAY 7–19, 1929

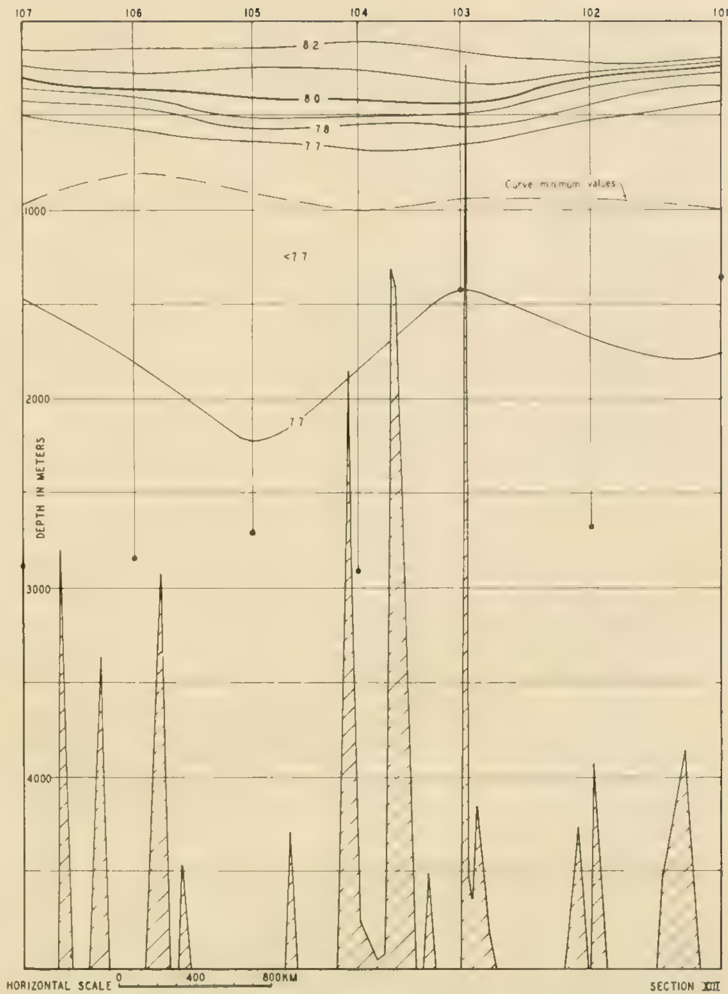


FIG. 175—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, MAY 7–19, 1929

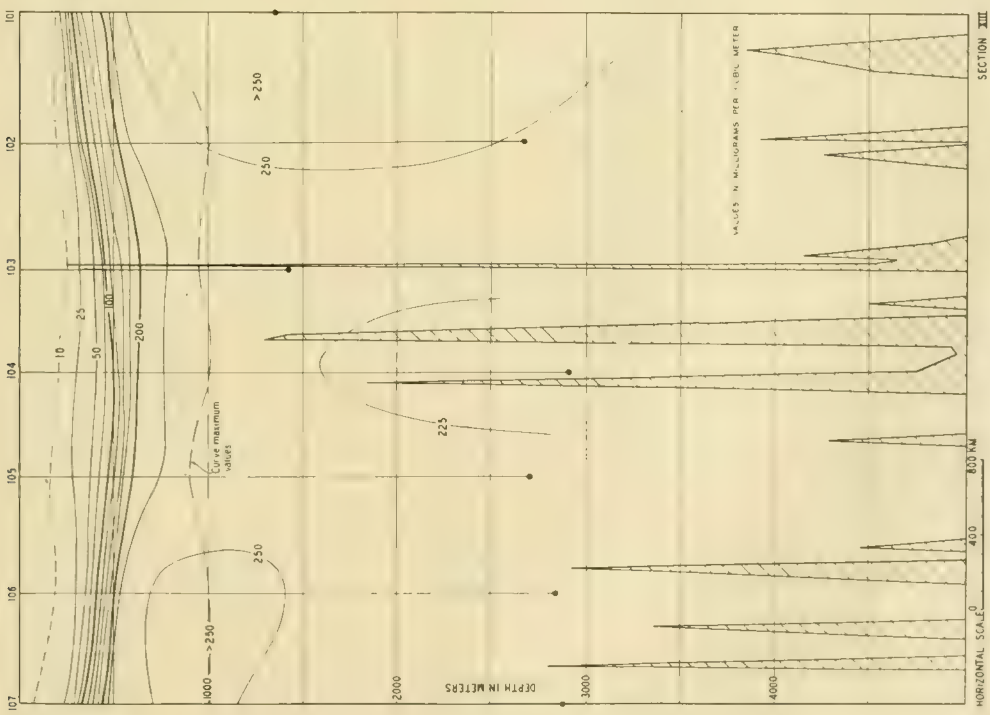


FIG. 176—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS
MAY 7-19, 1929

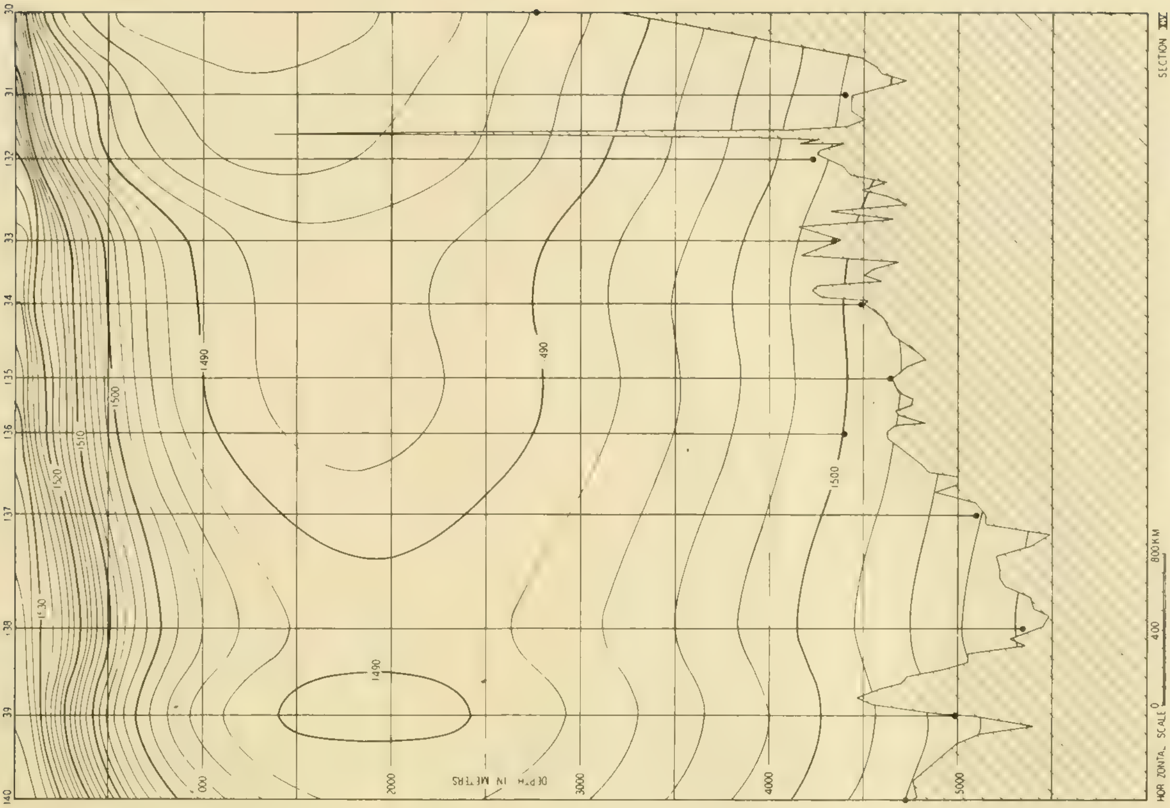


FIG. 177—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS
SEPTEMBER 4 TO OCTOBER 3, 1929

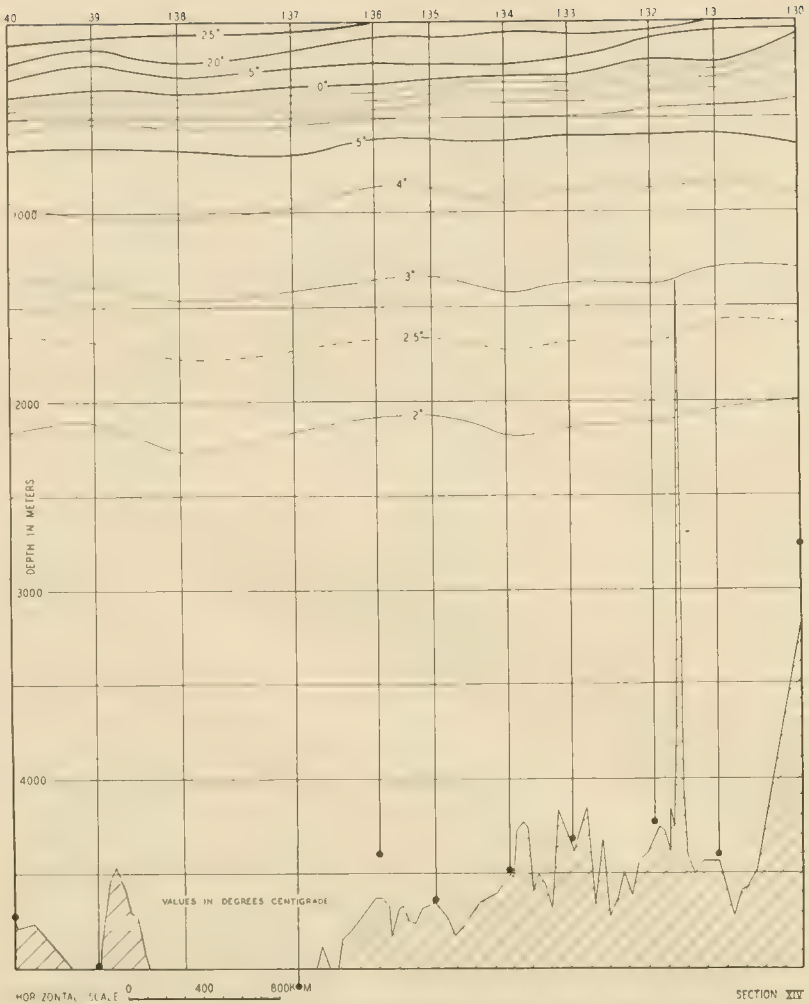


FIG. 178 VERTICAL DISTRIBUTION, TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 4 TO OCTOBER 3, 1929

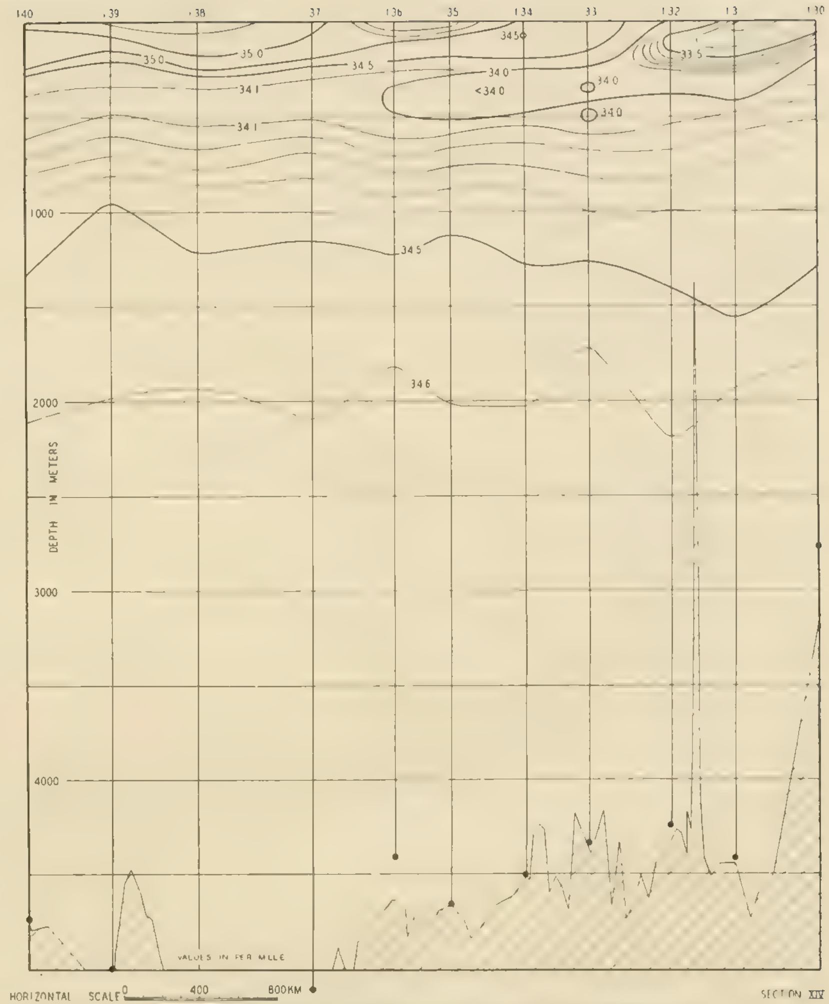
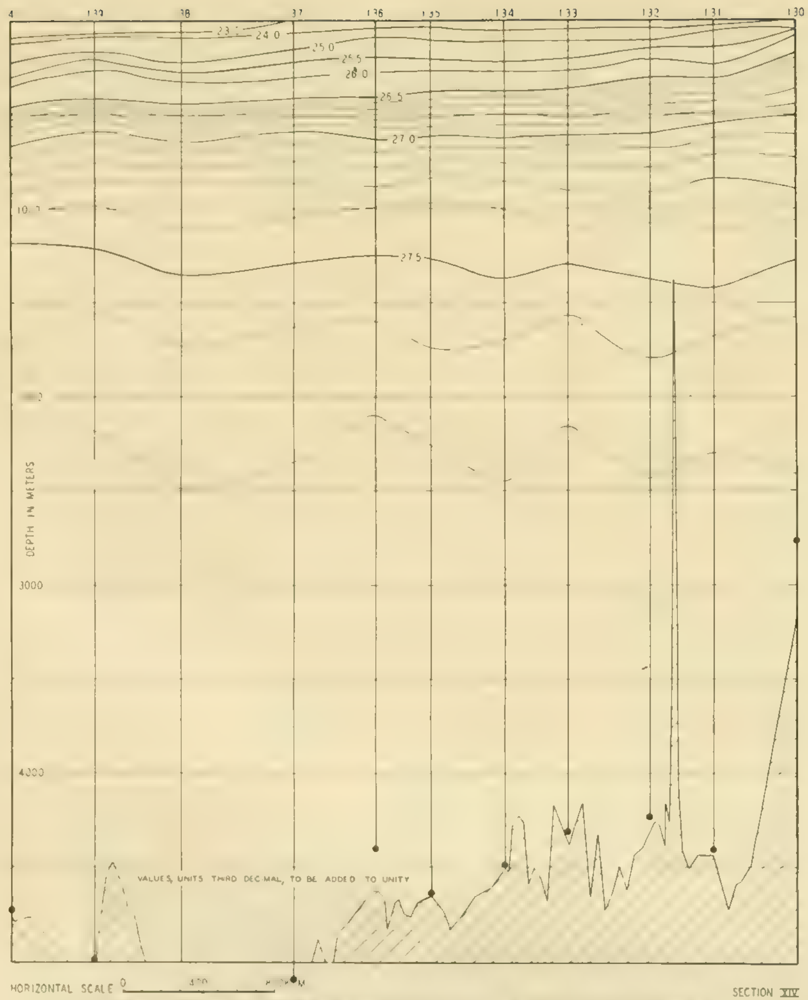


FIG. 179 VERTICAL DISTRIBUTION SALINITY PACIFIC OCEAN FROM CARNEGIE RESULTS, SEPTEMBER 4 TO OCTOBER 3, 1929



[illegible]—VERTICAL DISTRIBUTION, DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS
SEPTEMBER 4 TO OCTOBER 3, 1929

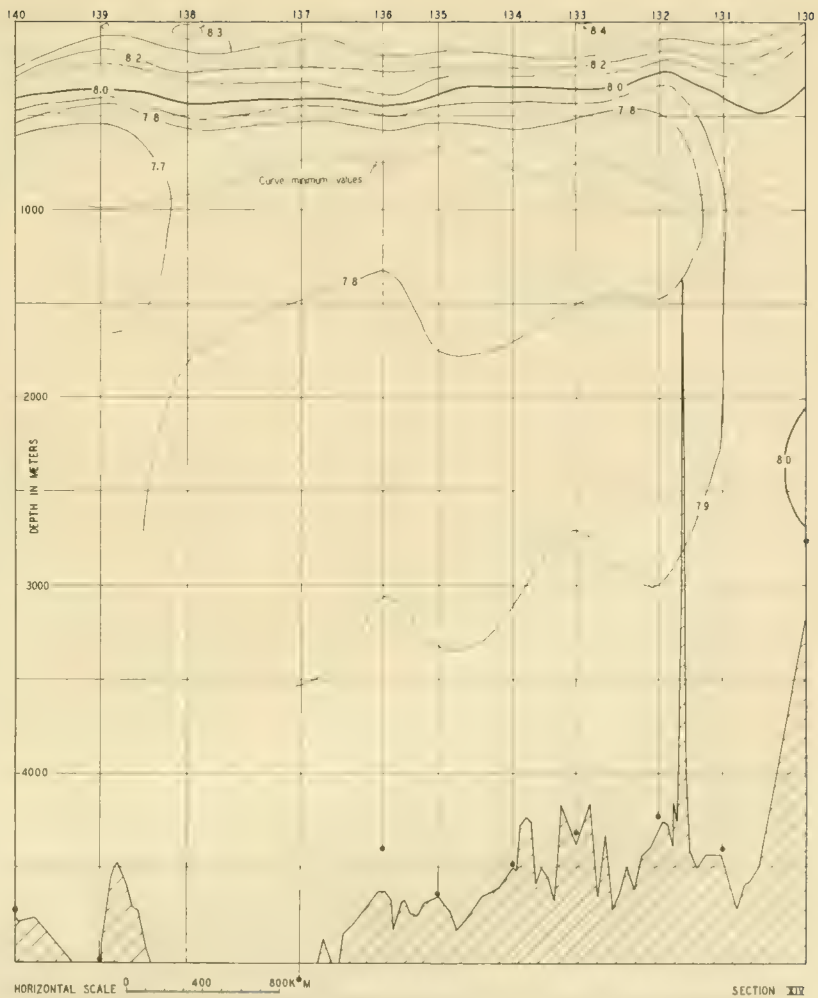


FIG. 181—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS
SEPTEMBER 4 TO OCTOBER 3, 1929

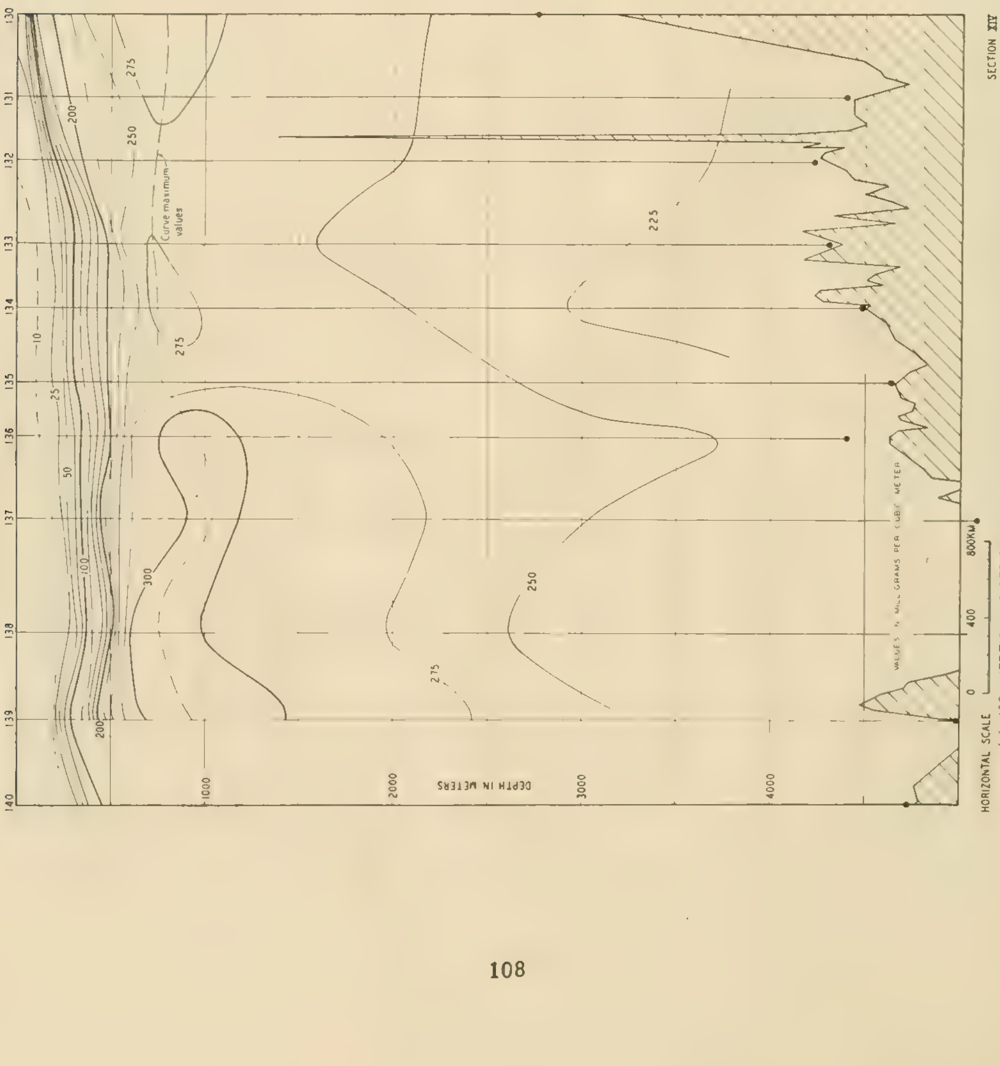


FIG. 182—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 4 TO OCTOBER 3, 1929

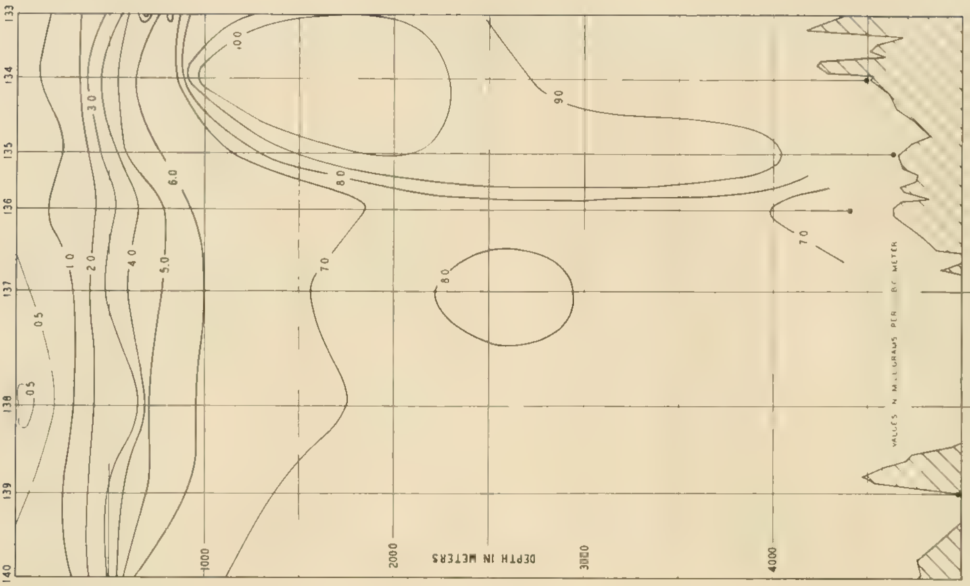


FIG. 183—VERTICAL DISTRIBUTION SILICA, PACIFIC OCEAN, FROM CARNEGIE RESULTS, SEPTEMBER 4 TO OCTOBER 3, 1929

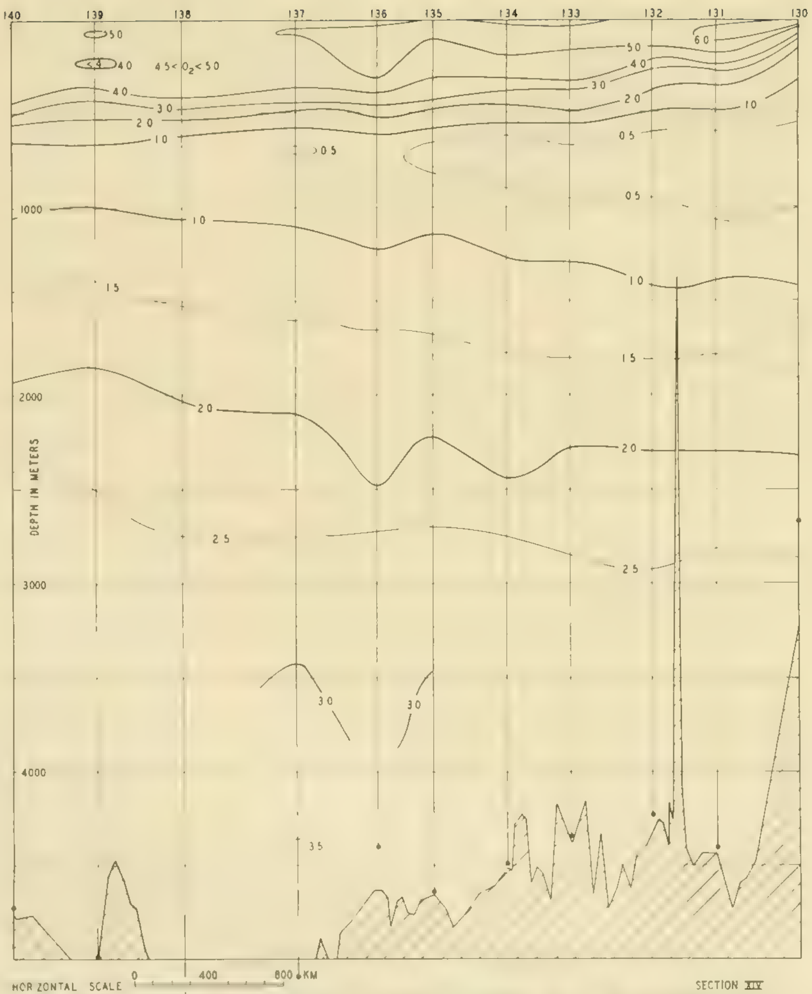


FIG. [illegible] VERTICAL DISTRIBUTION OXYGEN IN MILLILITERS PER LITER, PACIFIC OCEAN, FROM CARNEGIE RESULTS,
SEPTEMBER 4 TO OCTOBER 3, 1929

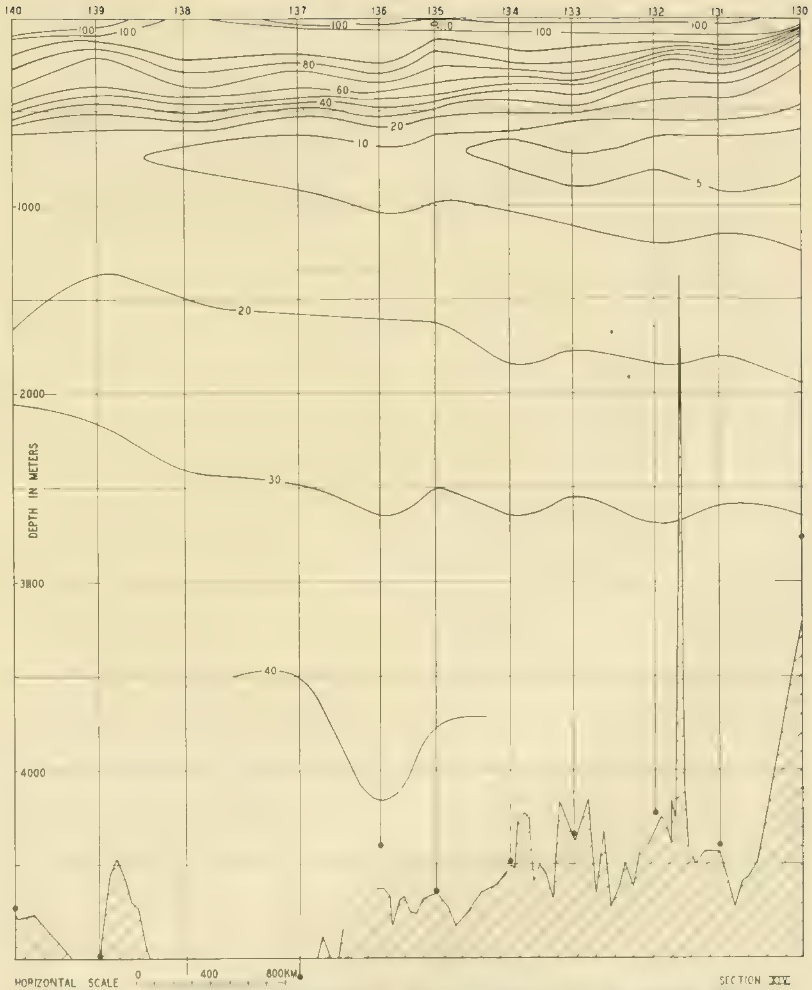
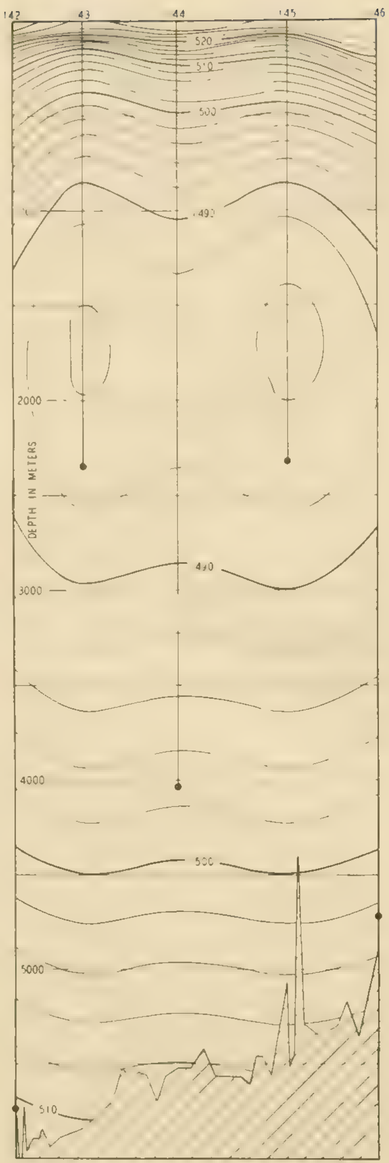
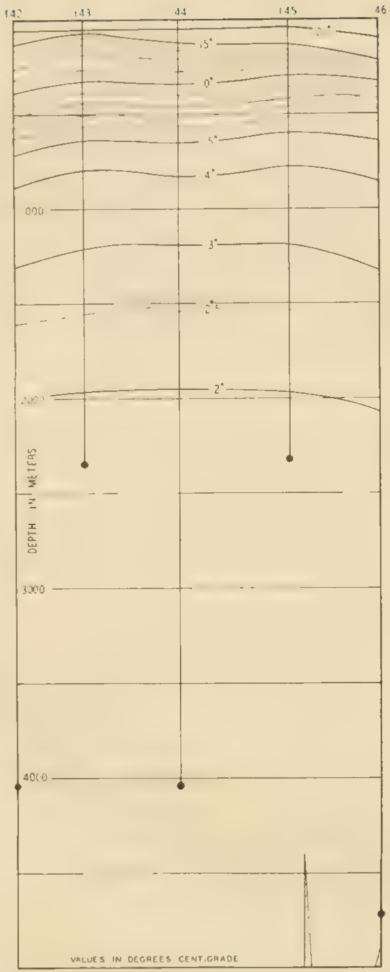


FIG. [illegible] VERTICAL DISTRIBUTION OXYGEN SATURATION IN PER CENT, PACIFIC OCEAN, FROM CARNEGIE RESULTS,
SEPTEMBER 4 TO OCTOBER 3, 1929



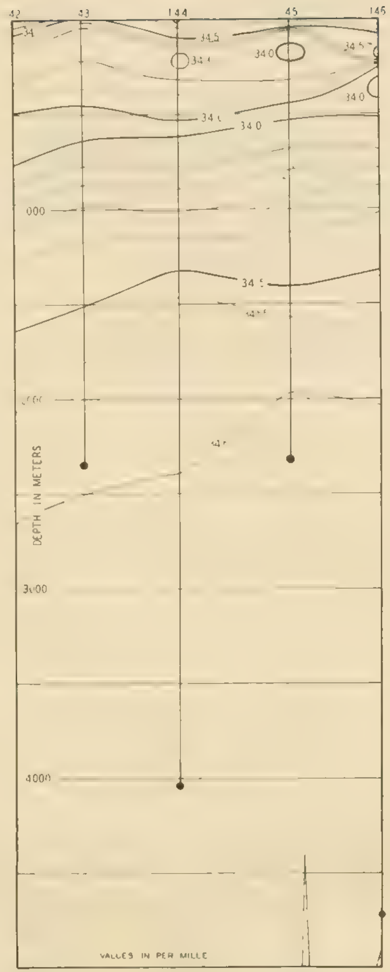
HORIZONTAL SCALE 0 400 800 SECTION XV

FIG. 186—VERTICAL DISTRIBUTION SOUNDING VELOCITY PACIFIC OCEAN FROM CARNEGIE RESULTS OCTOBER 7-15, 1929



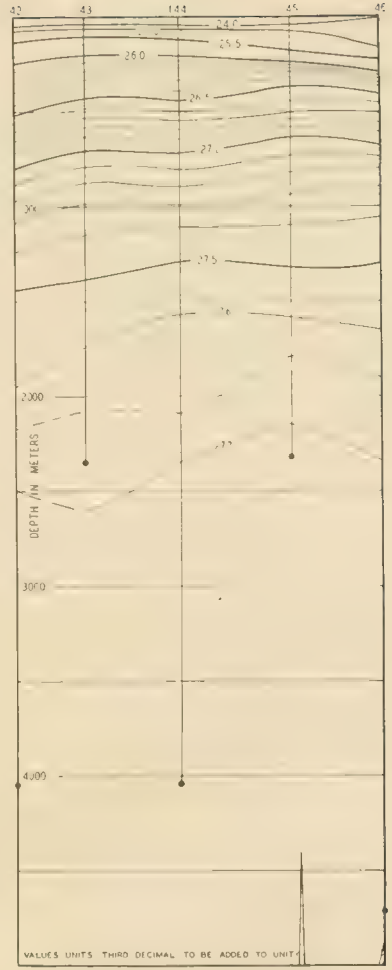
HORIZONTAL SCALE 0 400 800KM SECTION XV

FIG. 187—VERTICAL DISTRIBUTION TEMPERATURE PACIFIC OCEAN, FROM CARNEGIE RESULTS, OCTOBER 7-15, 1929



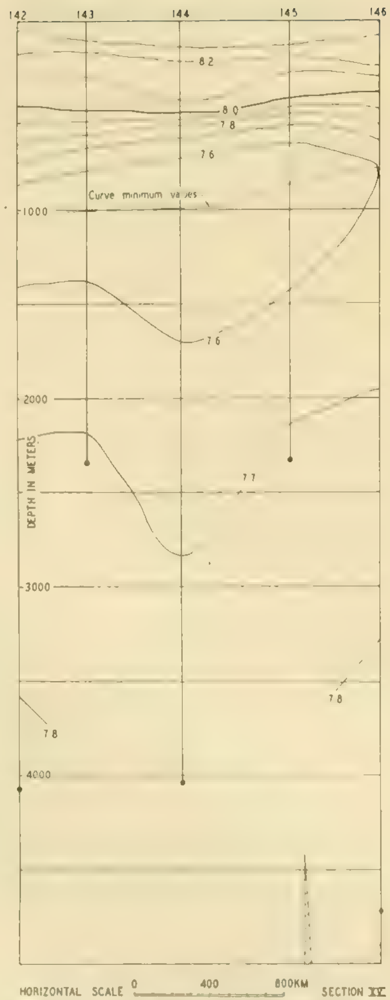
HORIZONTAL SCALE 0 400 800KM SECTION XV

FIG. 188—VERTICAL DISTRIBUTION SALINITY PACIFIC OCEAN, FROM CARNEGIE RESULTS OCTOBER 7-15, 1929

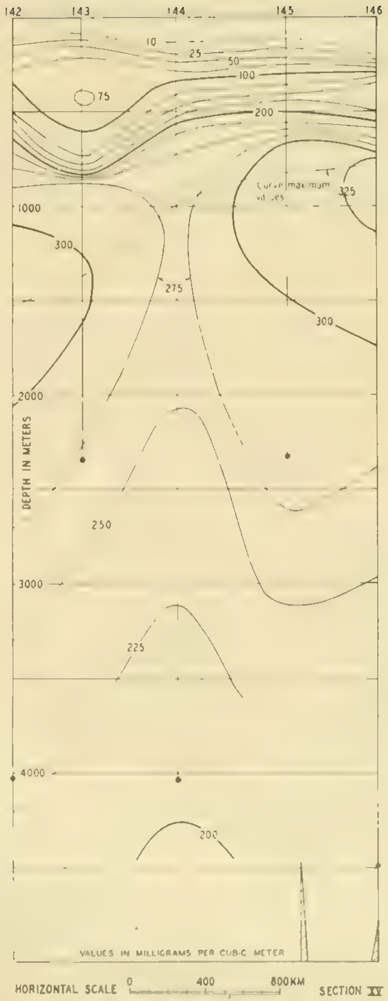


HORIZONTAL SCALE 0 400 800 KM SECTION XV

FIG. 189—VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS OCTOBER 7-15, 1929



[illegible] VERTICAL [illegible]
[illegible]
OCTOBER 7-15, 1929



[illegible] VERTICAL [illegible] PHOSPHATE,
[illegible] OCEAN, FROM [illegible] RESULTS,
OCTOBER 7-15, 1929

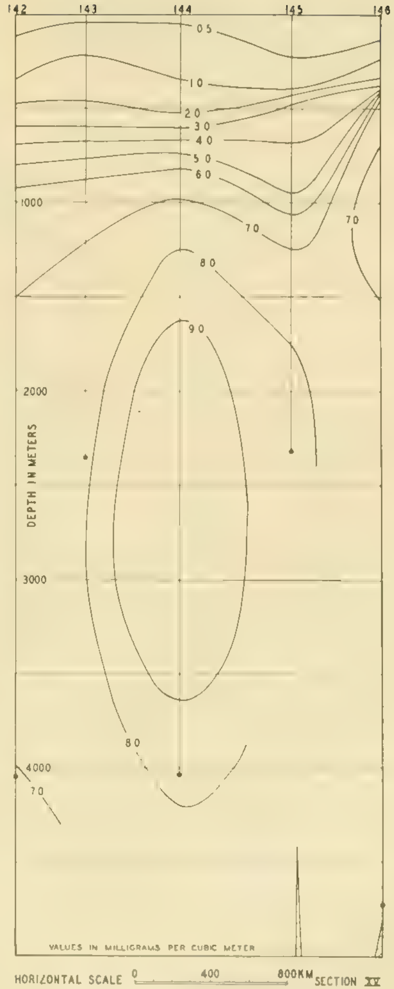


FIG 192—VERTICAL DISTRIBUTION SILICA, PACIFIC OCEAN,
FROM CARNEGIE RESULTS OCTOBER 7-15, 1929

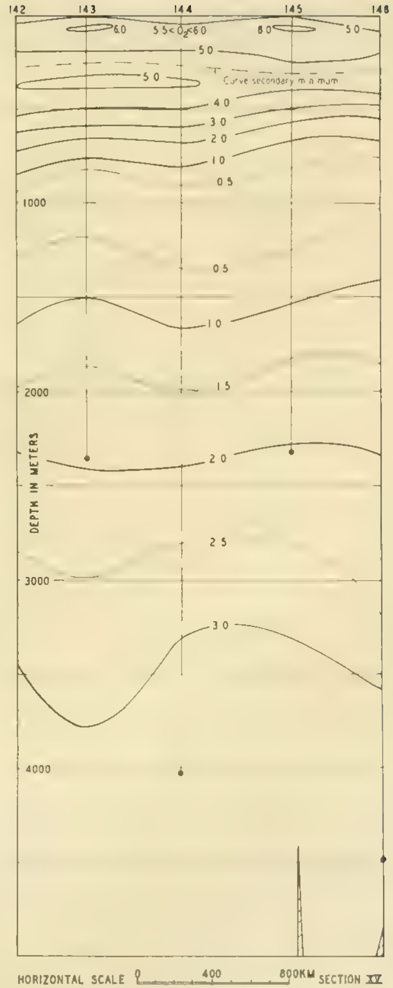


FIG. 193—VERTICAL DISTRIBUTION OXYGEN IN MILLILITERS
PER LITER PACIFIC OCEAN, FROM CARNEGIE RESULTS
OCTOBER 7-15, 1929

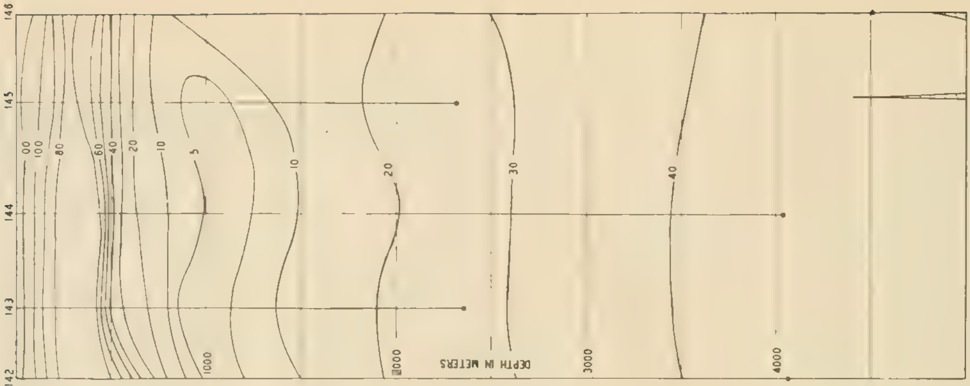
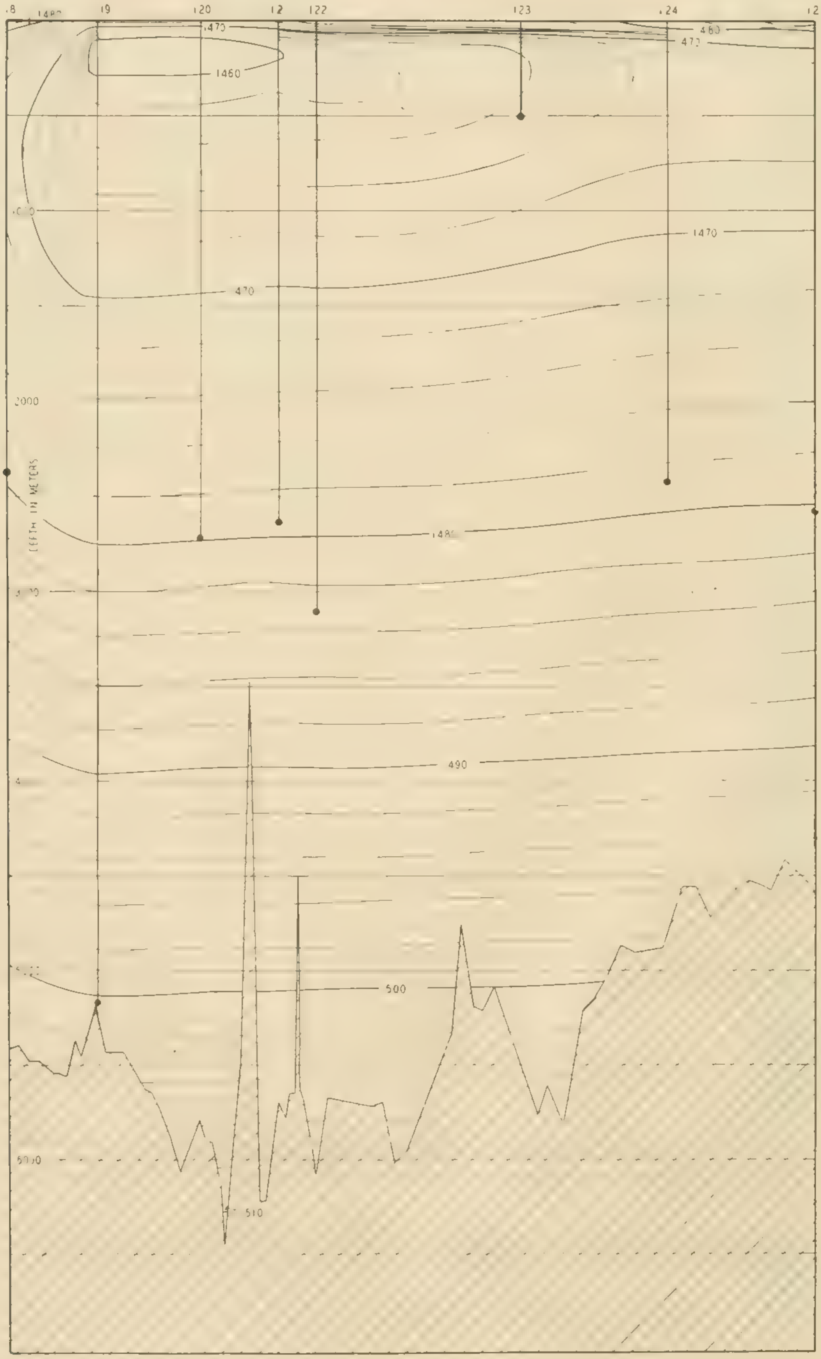


FIG.194—VERTICAL DISTRIBUTION OXYGEN SATURATION IN PER CENT, PACIFIC OCEAN, FROM CARNEGIE RESULTS, OCTOBER 7-15, 1929



HORIZONTAL SCALE 0 400 800KM SECTION XVI

FIG. 195—VERTICAL DISTRIBUTION SOUNDING VELOCITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 5-19, 1929

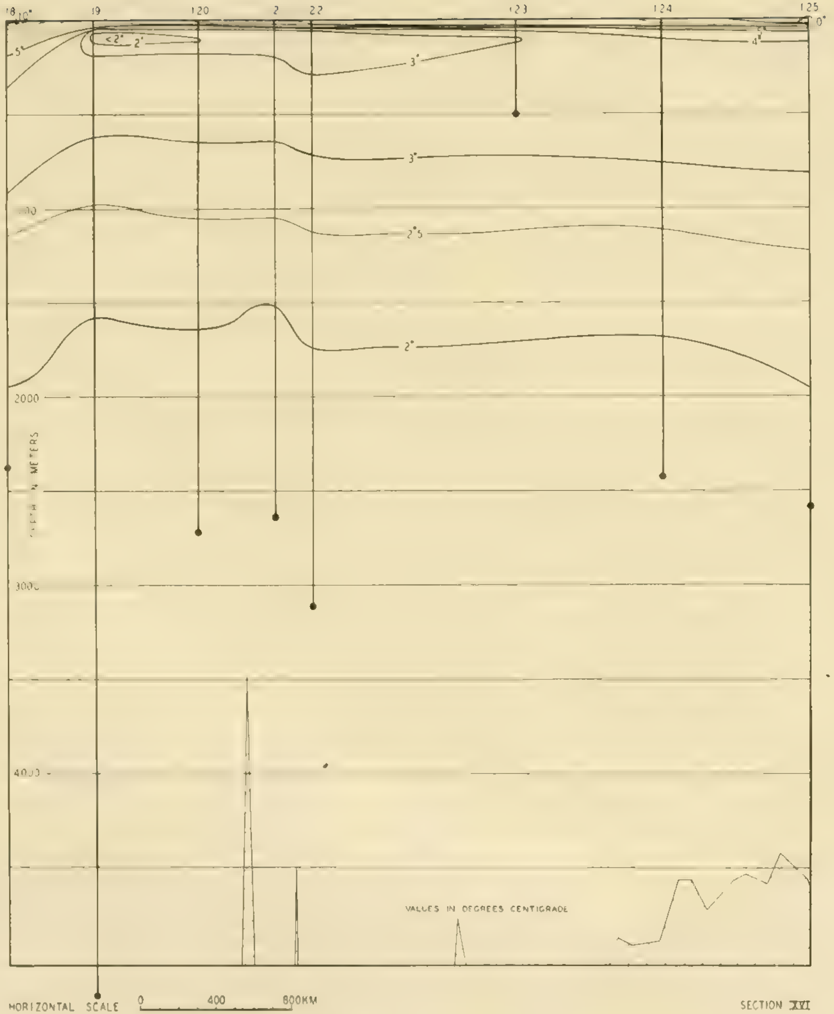


FIG 196—VERTICAL DISTRIBUTION TEMPERATURE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 5–19, 1929

FIG 197—VERTICAL DISTRIBUTION SALINITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 5–19 1929

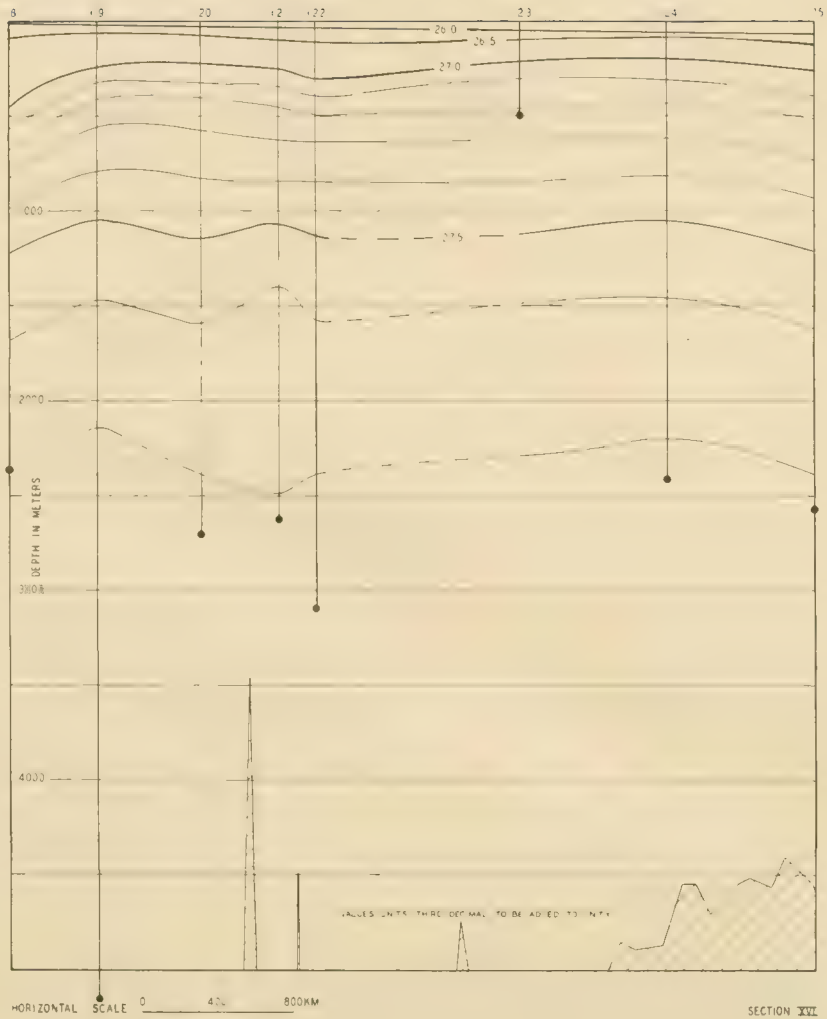


FIG 198—VERTICAL DISTRIBUTION DENSITY, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 5-19, 1929

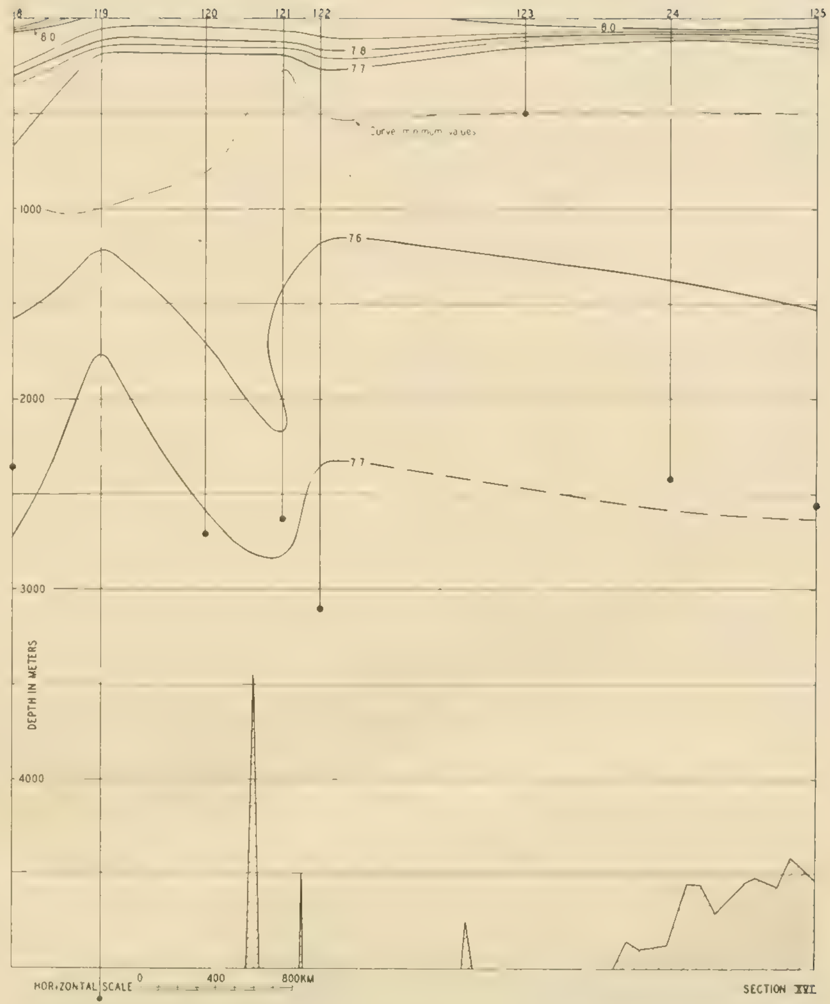


FIG.199—VERTICAL DISTRIBUTION HYDROGEN ION, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 5-19, 1929

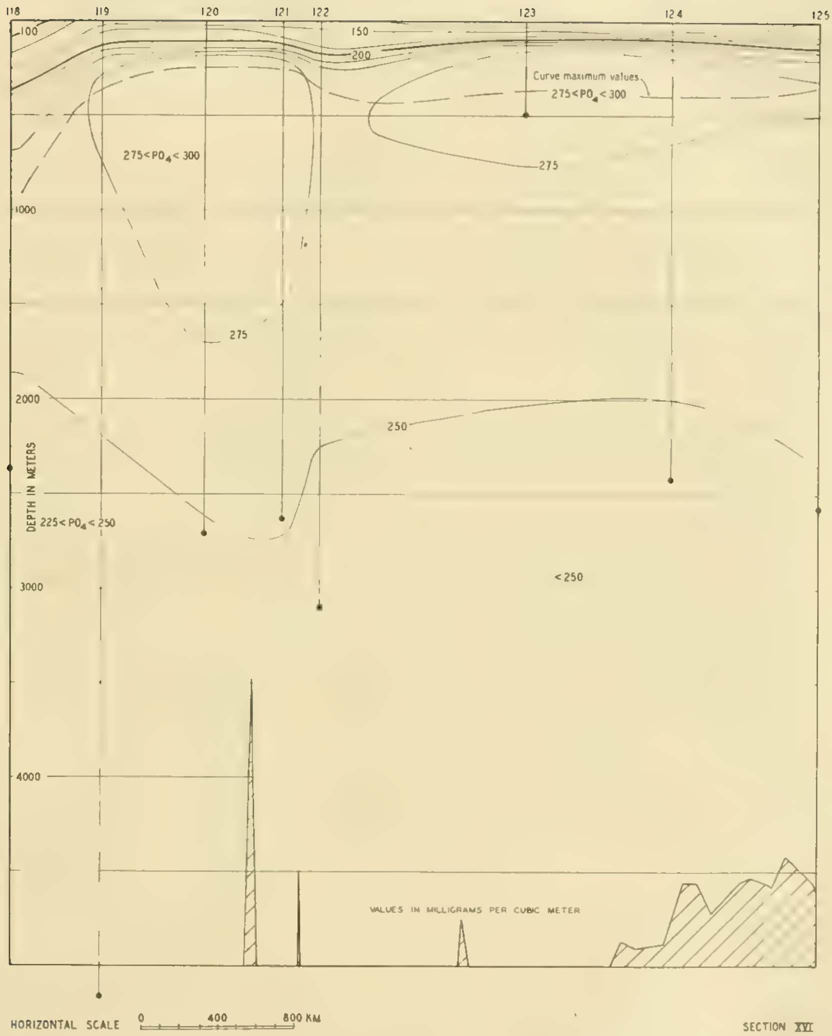


FIG. 200—VERTICAL DISTRIBUTION PHOSPHATE, PACIFIC OCEAN, FROM CARNEGIE RESULTS, JULY 5-19, 1929

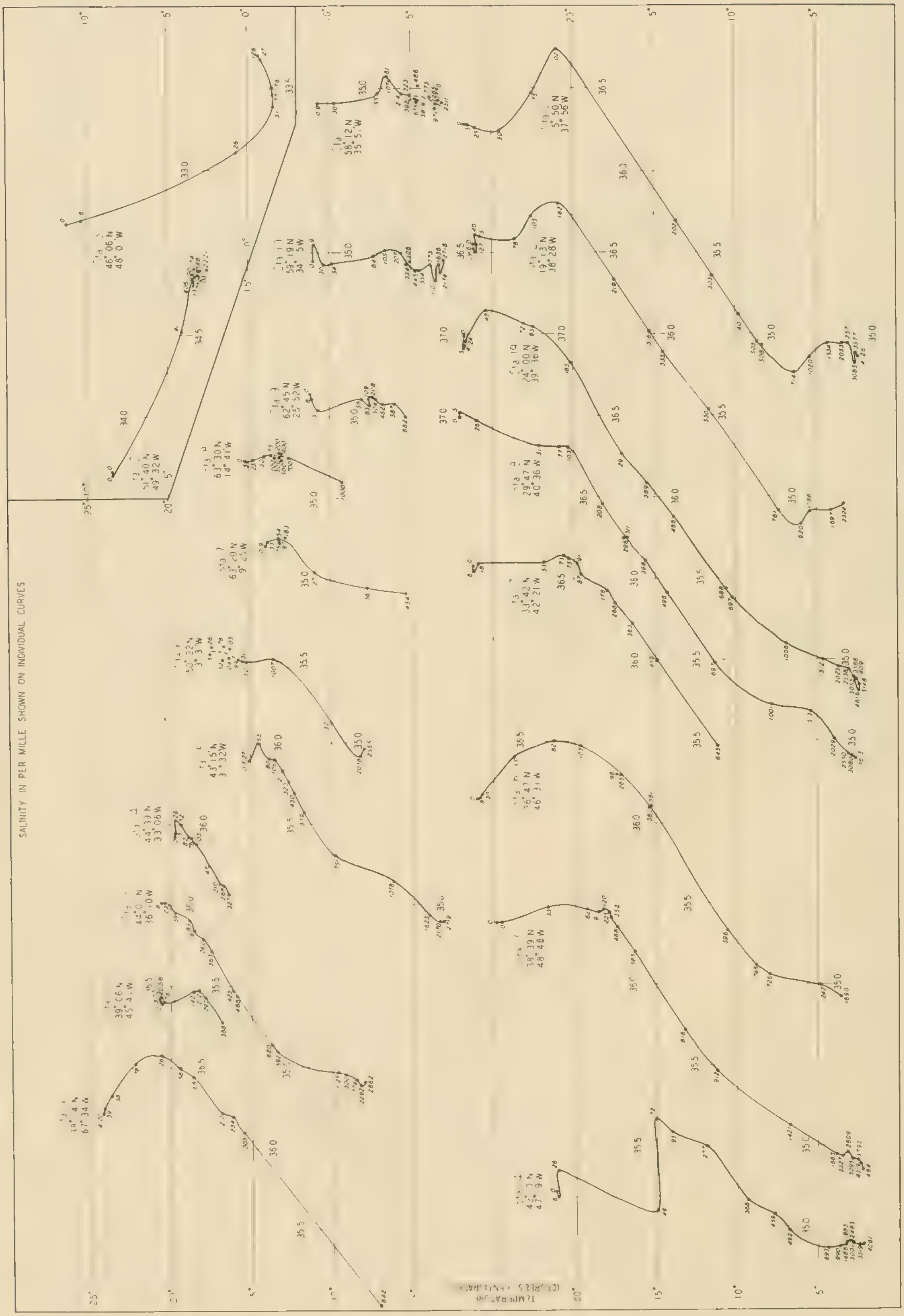


FIG. 201—TEMPERATURE-SALINITY RELATION, STATIONS 1–21, ATLANTIC OCEAN, FROM CARNEGIE RESULTS, 1928

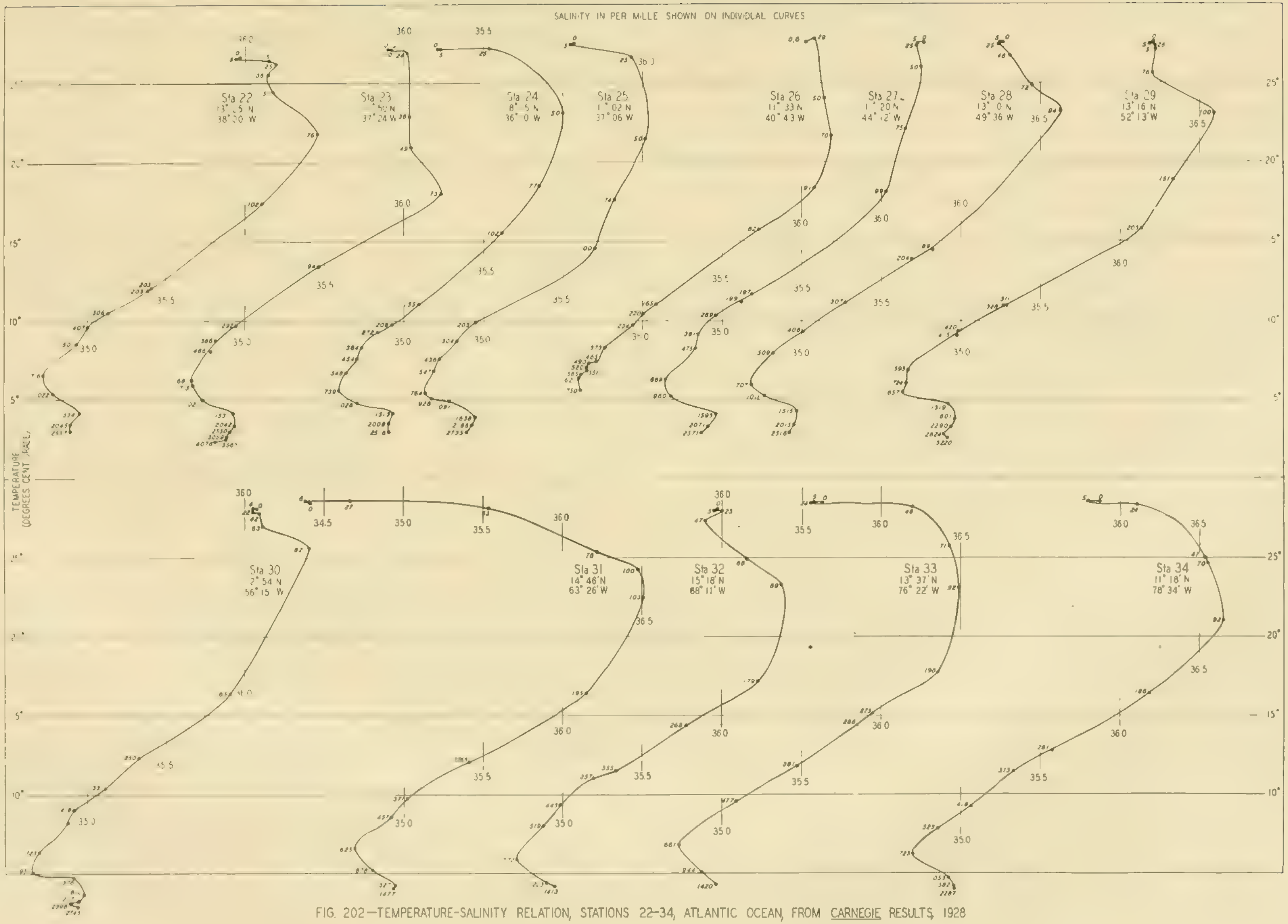


FIG. 202—TEMPERATURE-SALINITY RELATION, STATIONS 22–34, ATLANTIC OCEAN, FROM CARNEGIE RESULTS, 1928

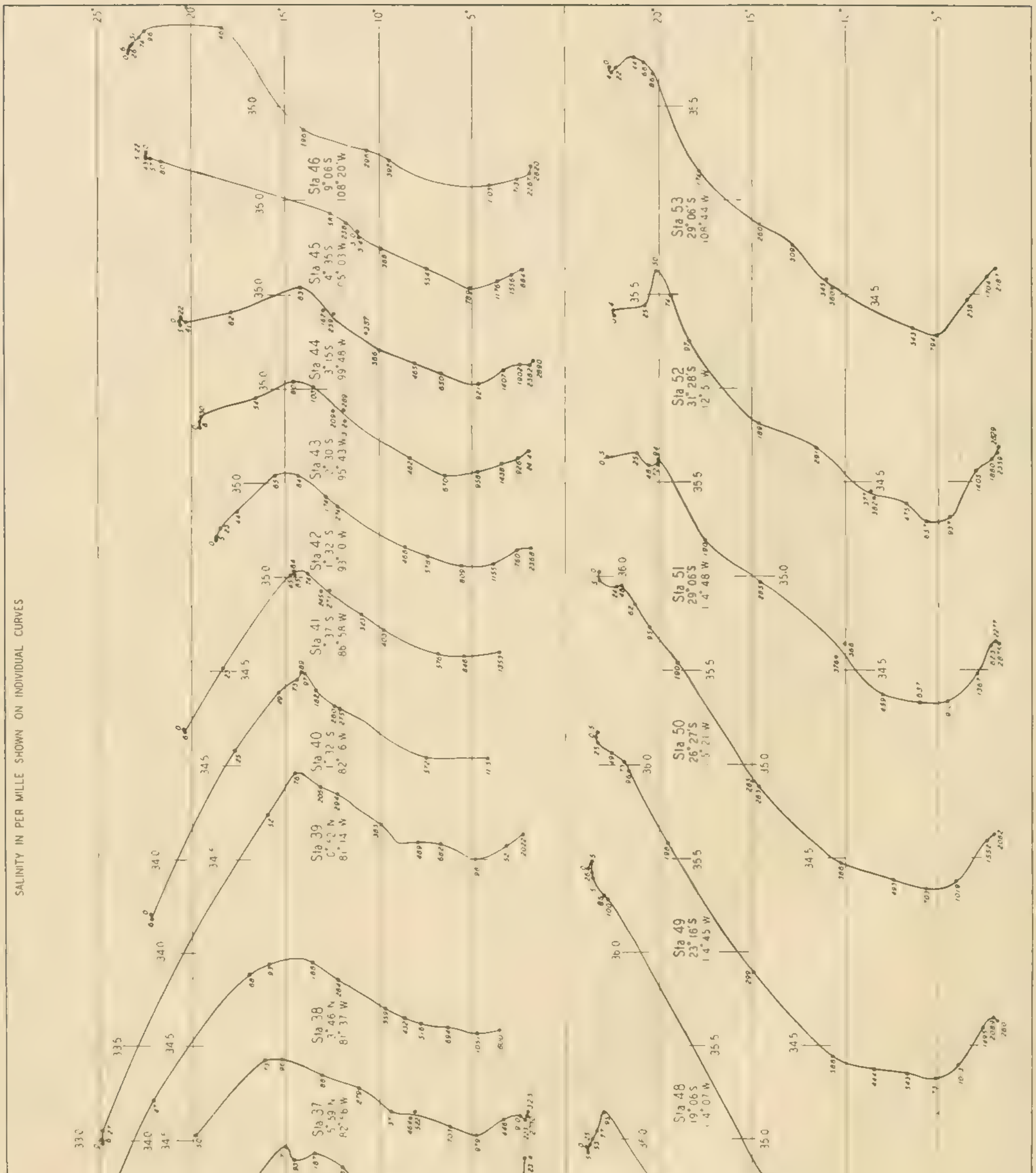


FIG 203—TEMPERATURE-SALINITY RELATION STATIONS 35–53, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928

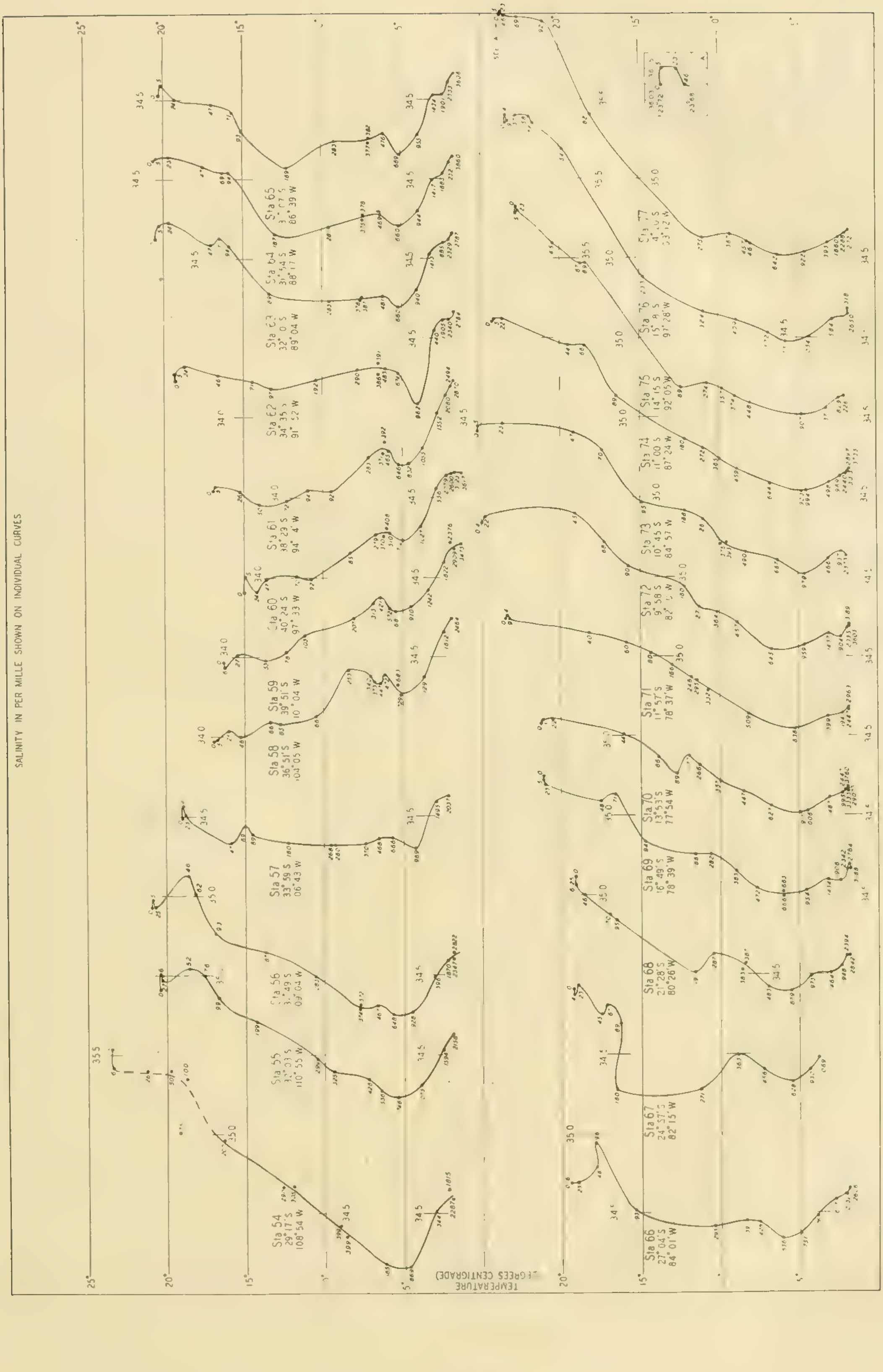


FIG. 204—TEMPERATURE-SALINITY RELATION, STATIONS 54–77, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1928–1929

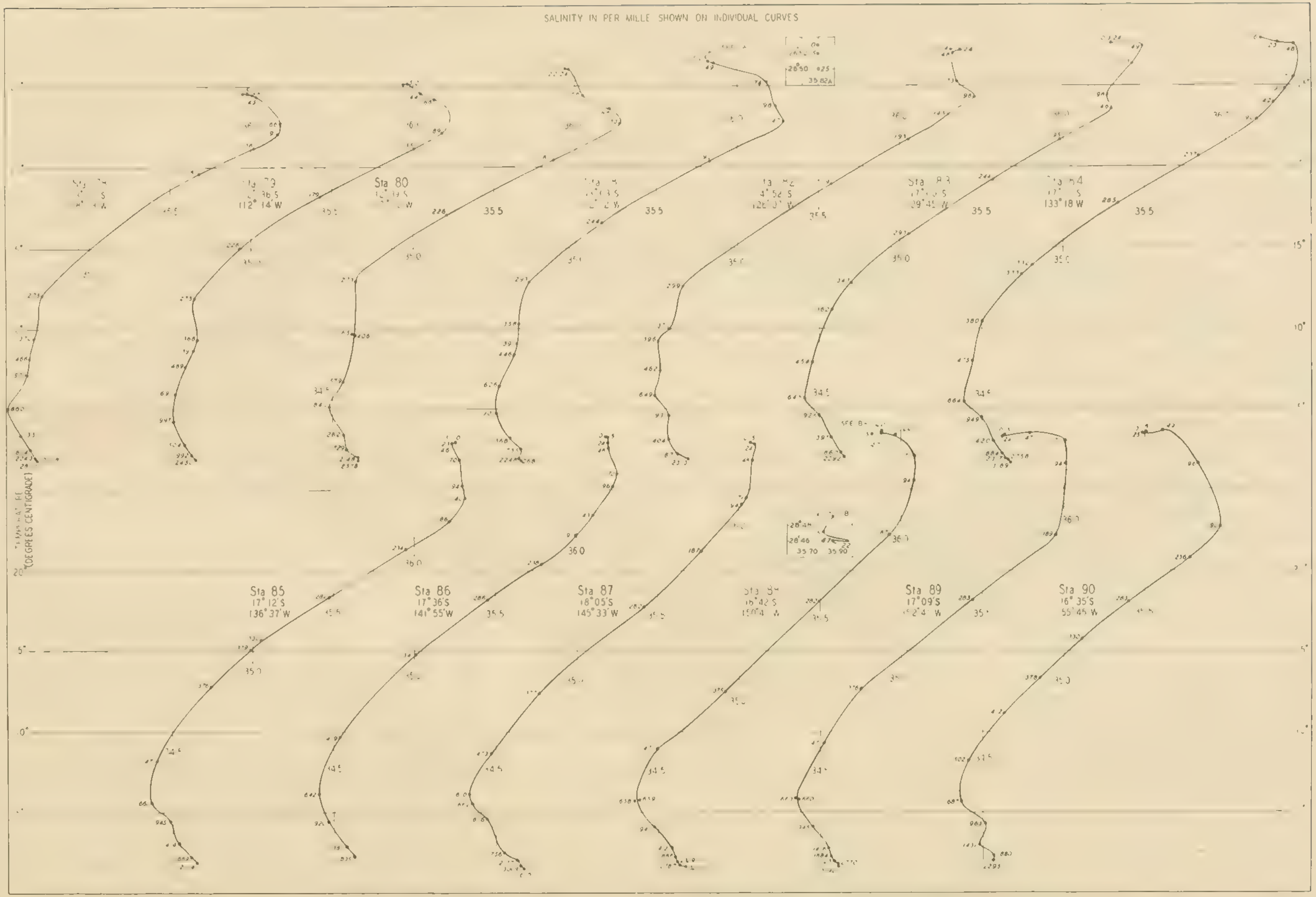


FIG. 205—TEMPERATURE-SALINITY RELATION, STATIONS 78—90, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1929

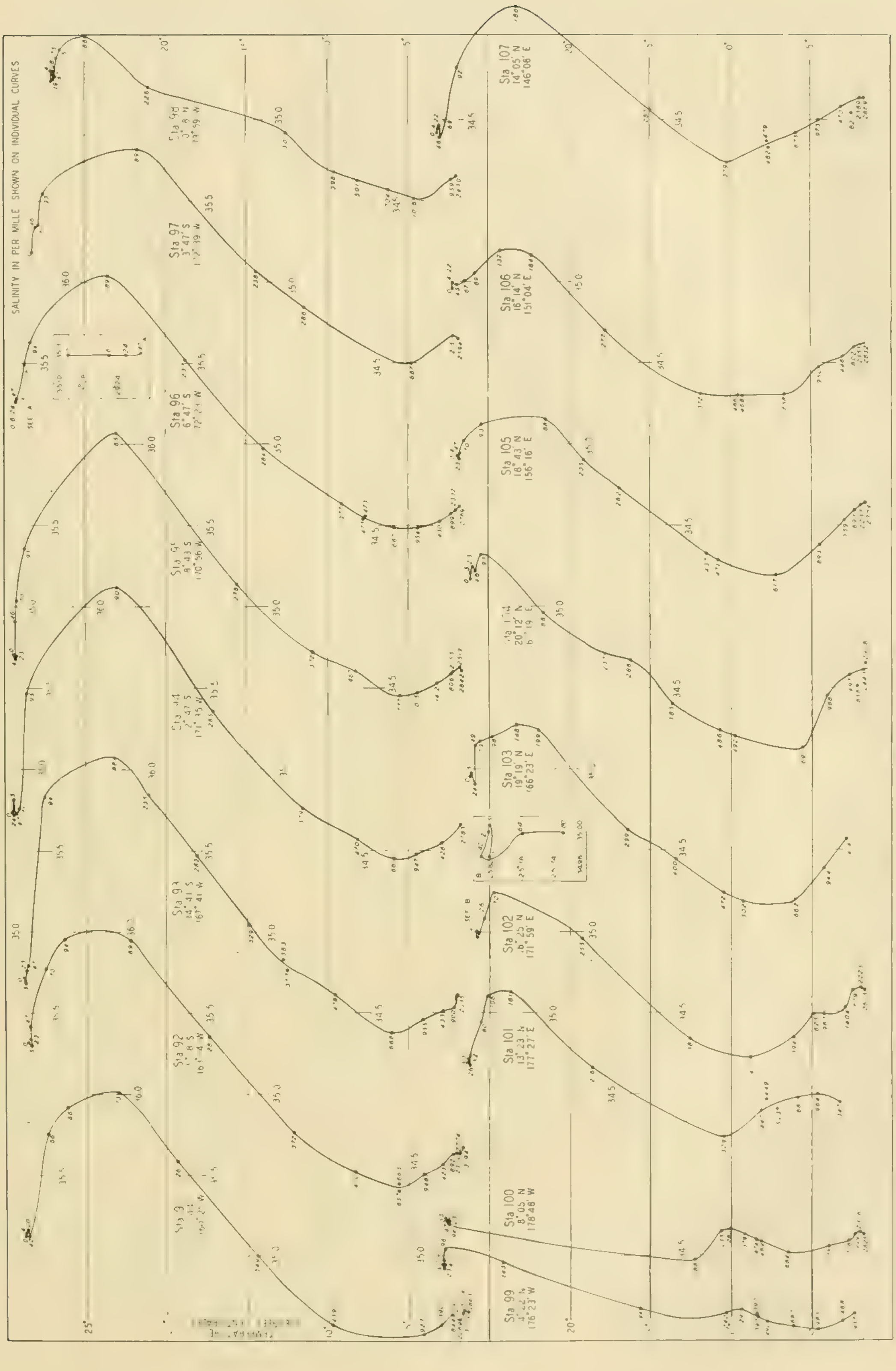


FIG 206—TEMPERATURE-SALINITY RELATIONS, STATIONS 91–107, PACIFIC OCEAN, FROM <u>CARNEGIE</u> RESULTS, 1929

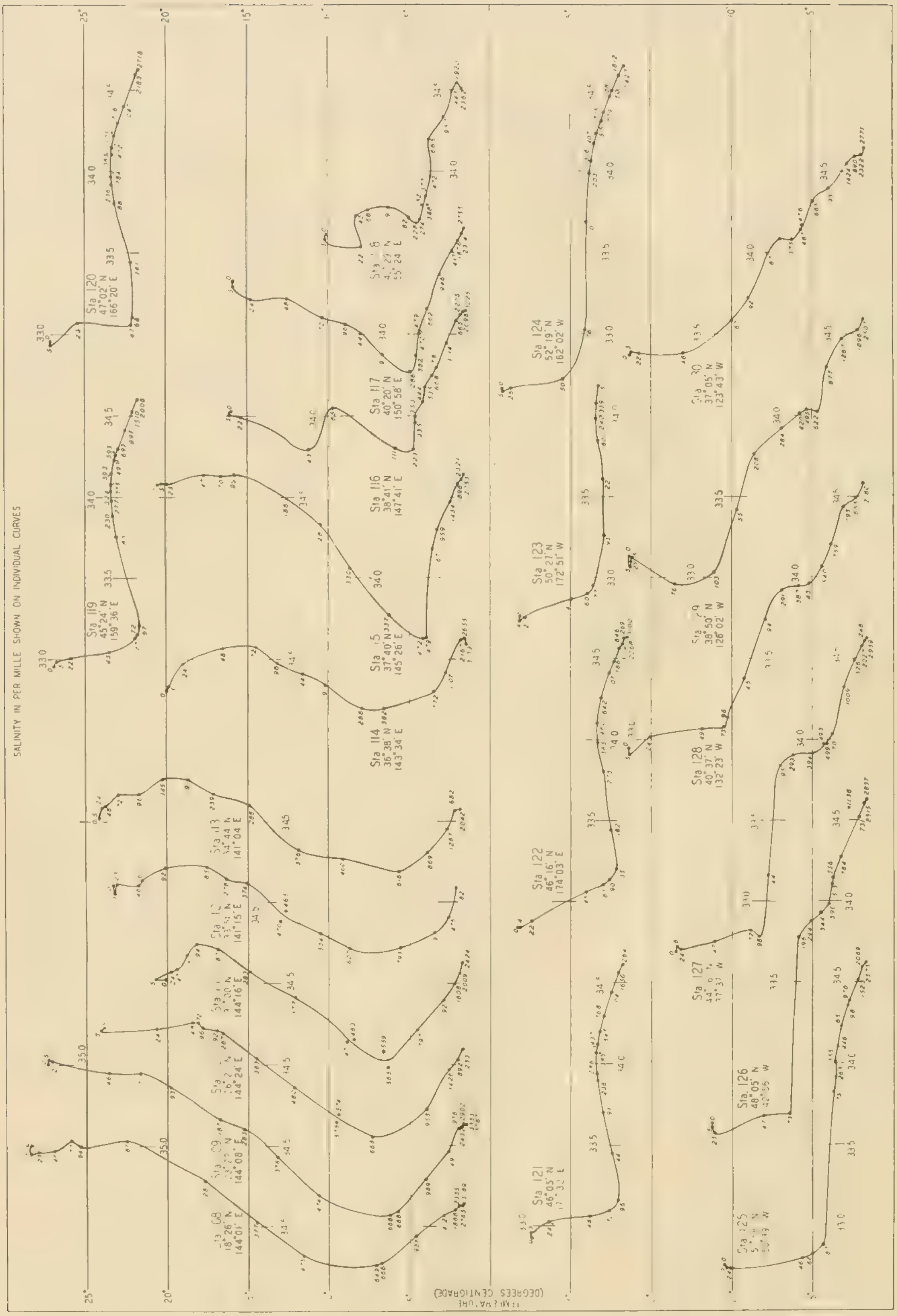
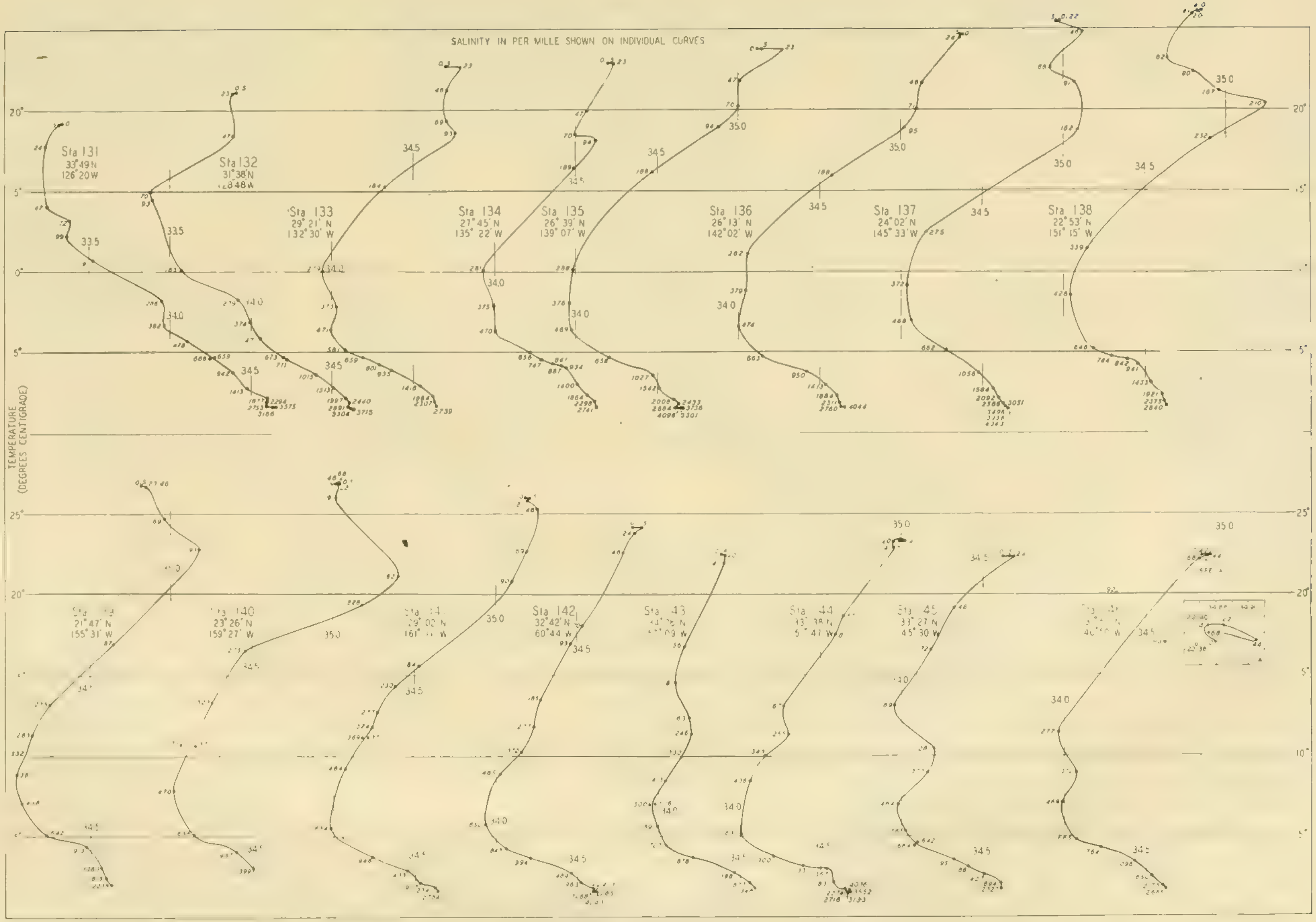


FIG 207—TEMPERATURE-SALINITY RELATION, STATIONS 108–130, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1929



PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1929

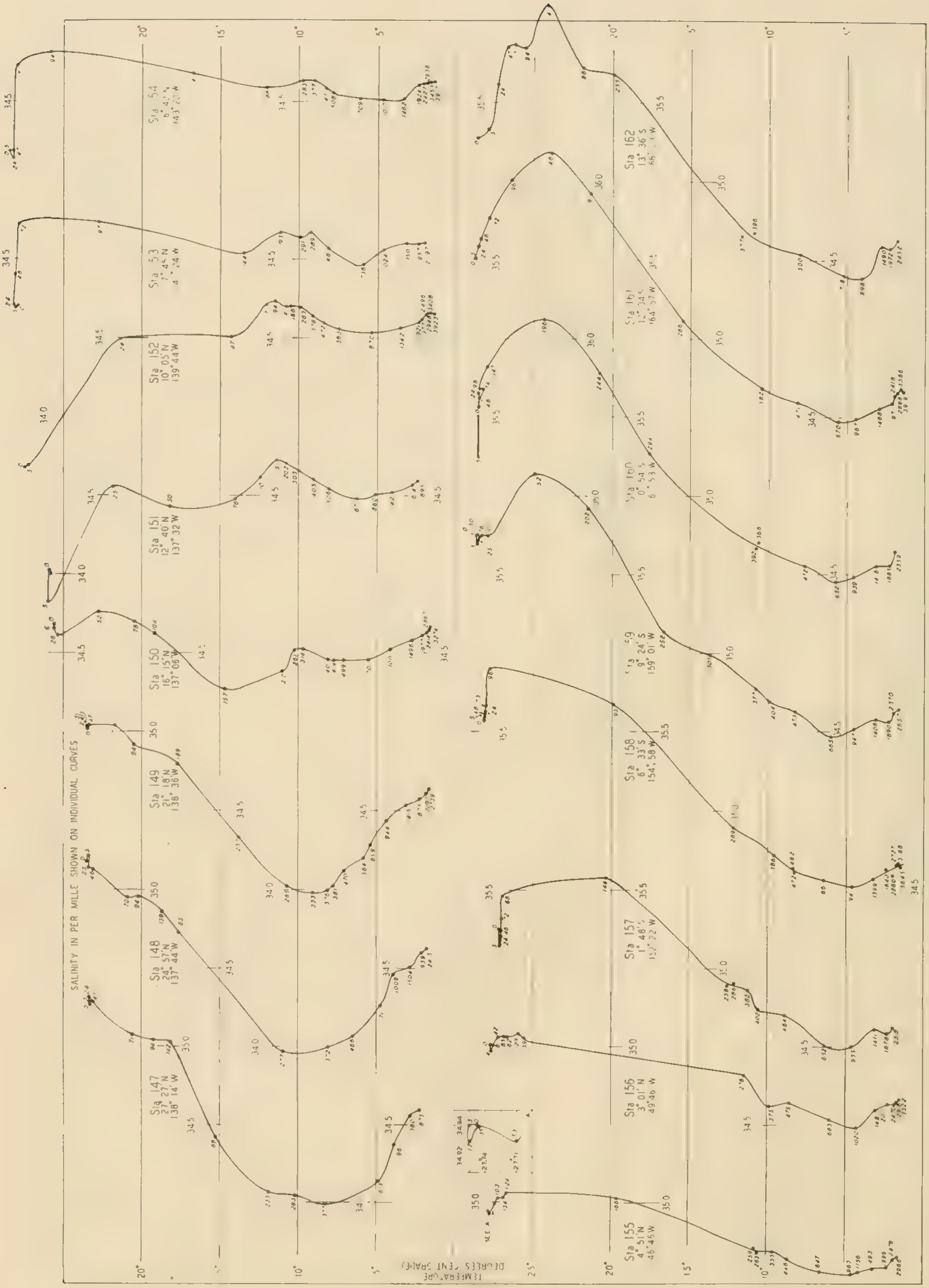


FIG. 209—TEMPERATURE-SALINITY RELATION, STATIONS 147–162, PACIFIC OCEAN, FROM CARNEGIE RESULTS, 1929

FIG. 210—HORIZONTAL DISTRIBUTION TEMPERATURE AT SURFACE, FROM CARNEGIE RESULTS, 1928-1929

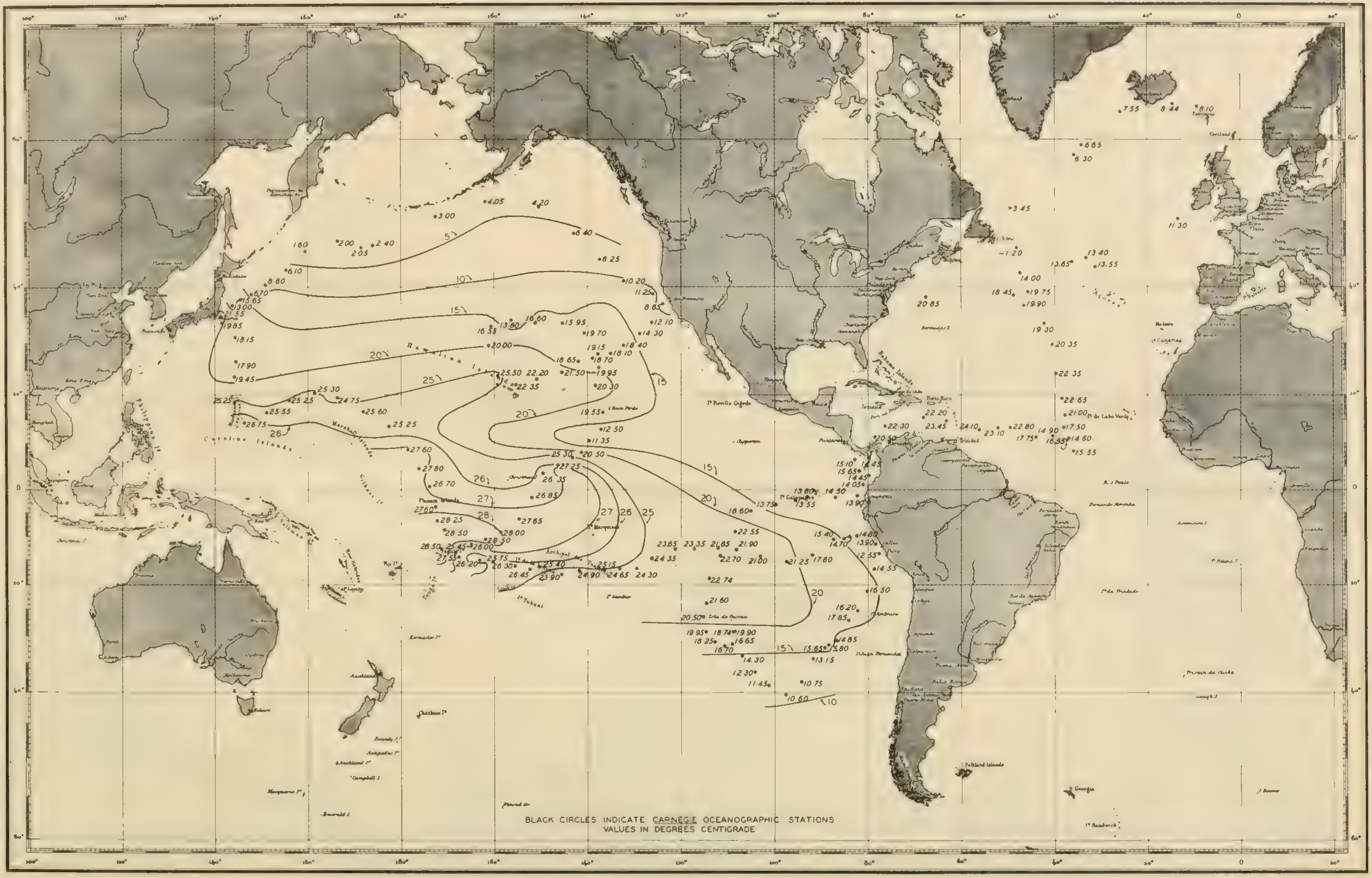


FIG. 211—HORIZONTAL DISTRIBUTION TEMPERATURE AT 100 METERS, FROM CARNEGIE RESULTS, 1928-1929

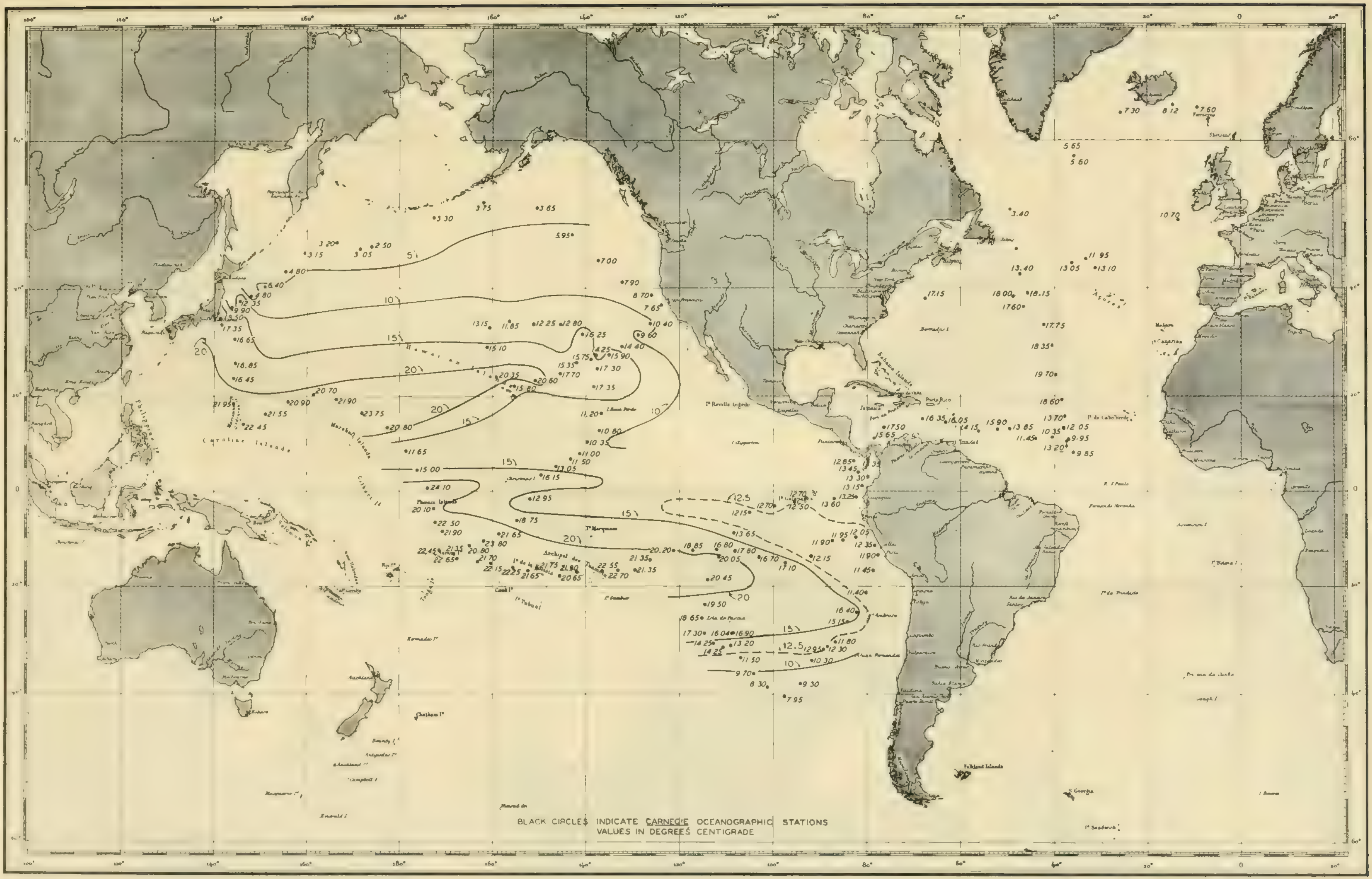


FIG 212—HORIZONTAL DISTRIBUTION TEMPERATURE AT 200 METERS, FROM CARNEGIE RESULTS, 1928-1929

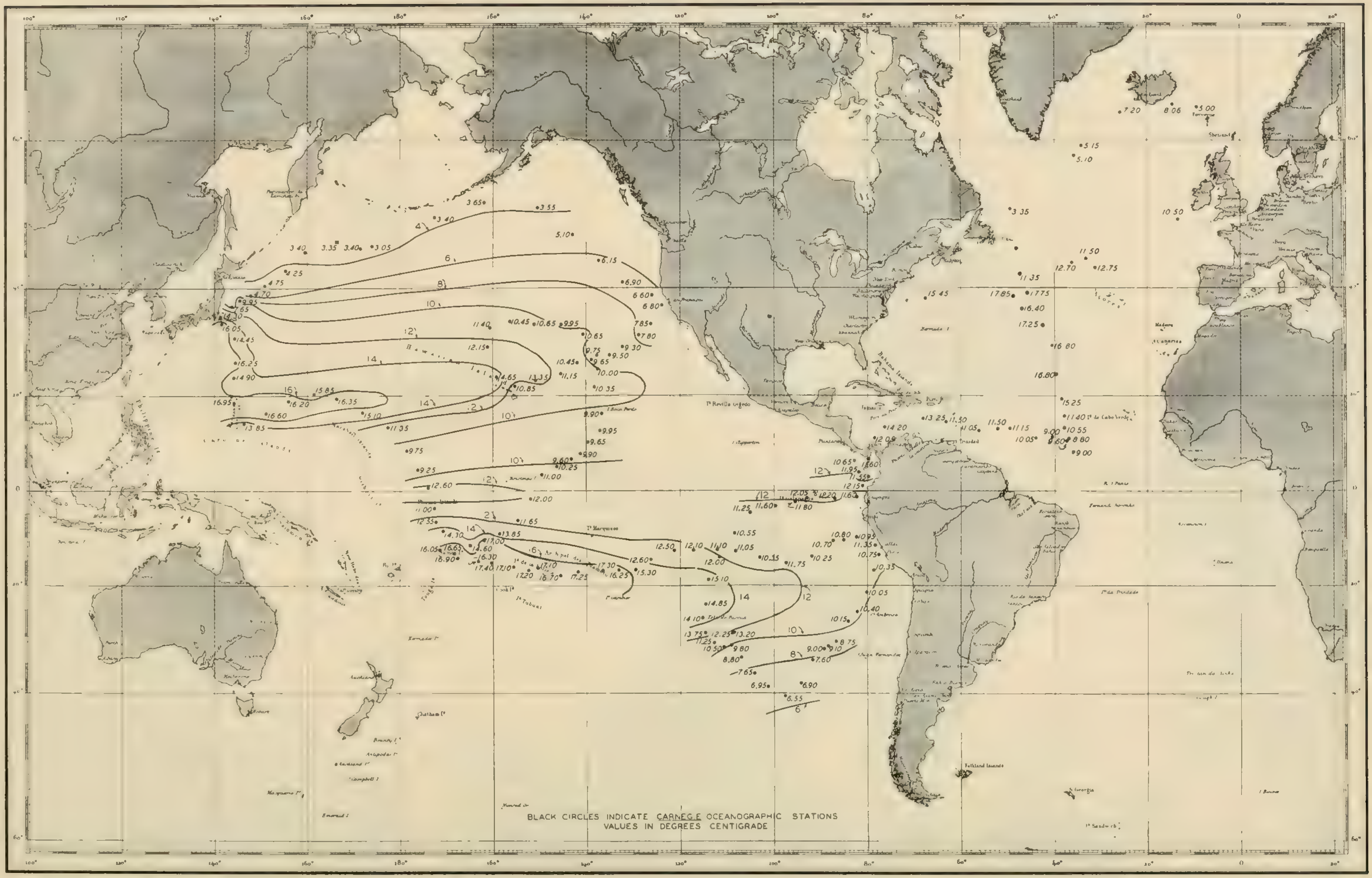


FIG. 213—HORIZONTAL DISTRIBUTION TEMPERATURE AT 300 METERS, FROM CARNEGIE RESULTS, 1928-1929

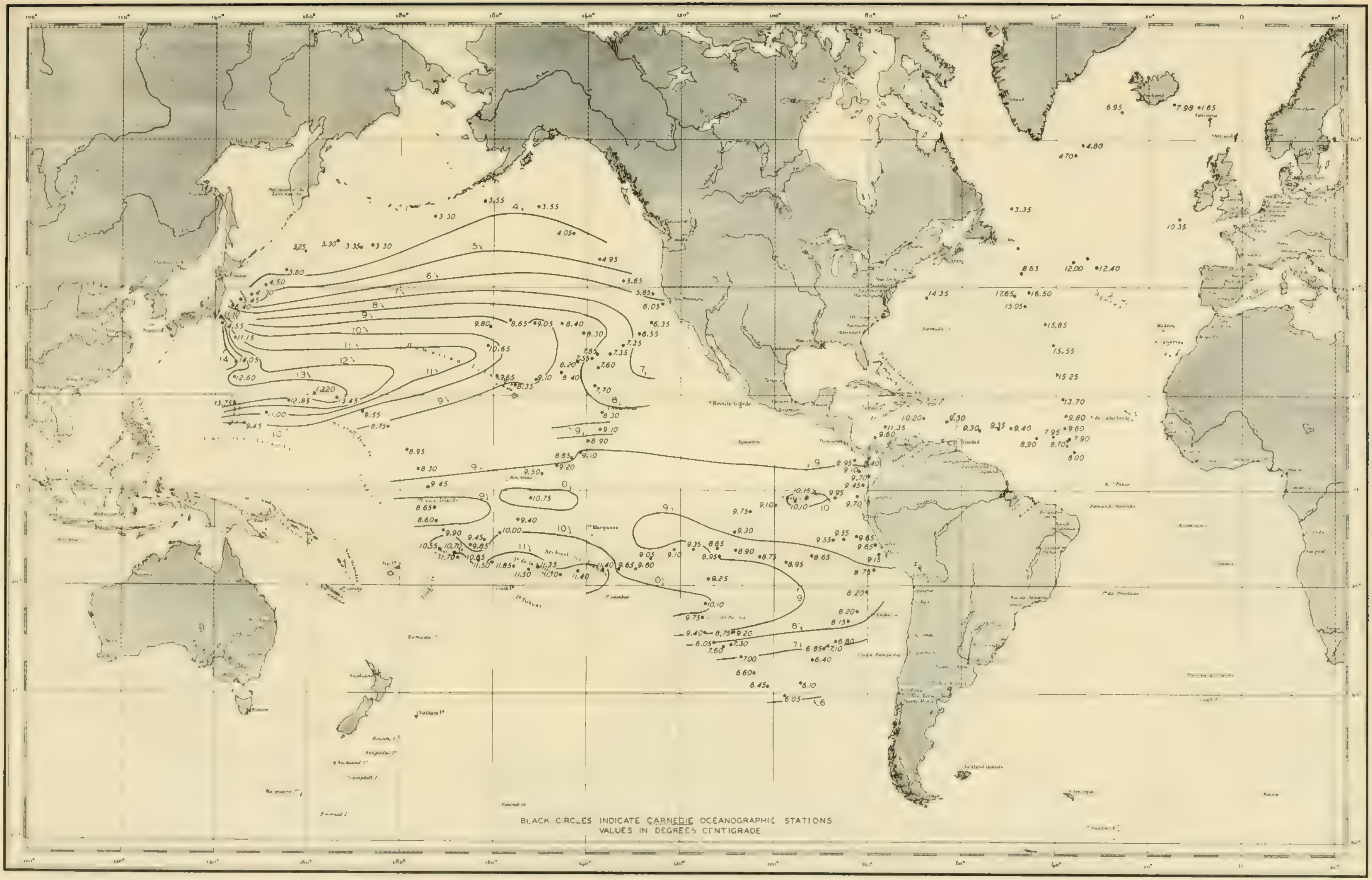


FIG. 214—HORIZONTAL DISTRIBUTION TEMPERATURE AT 400 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 215—HORIZONTAL DISTRIBUTION TEMPERATURE AT 500 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 216—HORIZONTAL DISTRIBUTION TEMPERATURE AT 700 METERS, FROM CARNEGIE RESULTS, 1928–1929

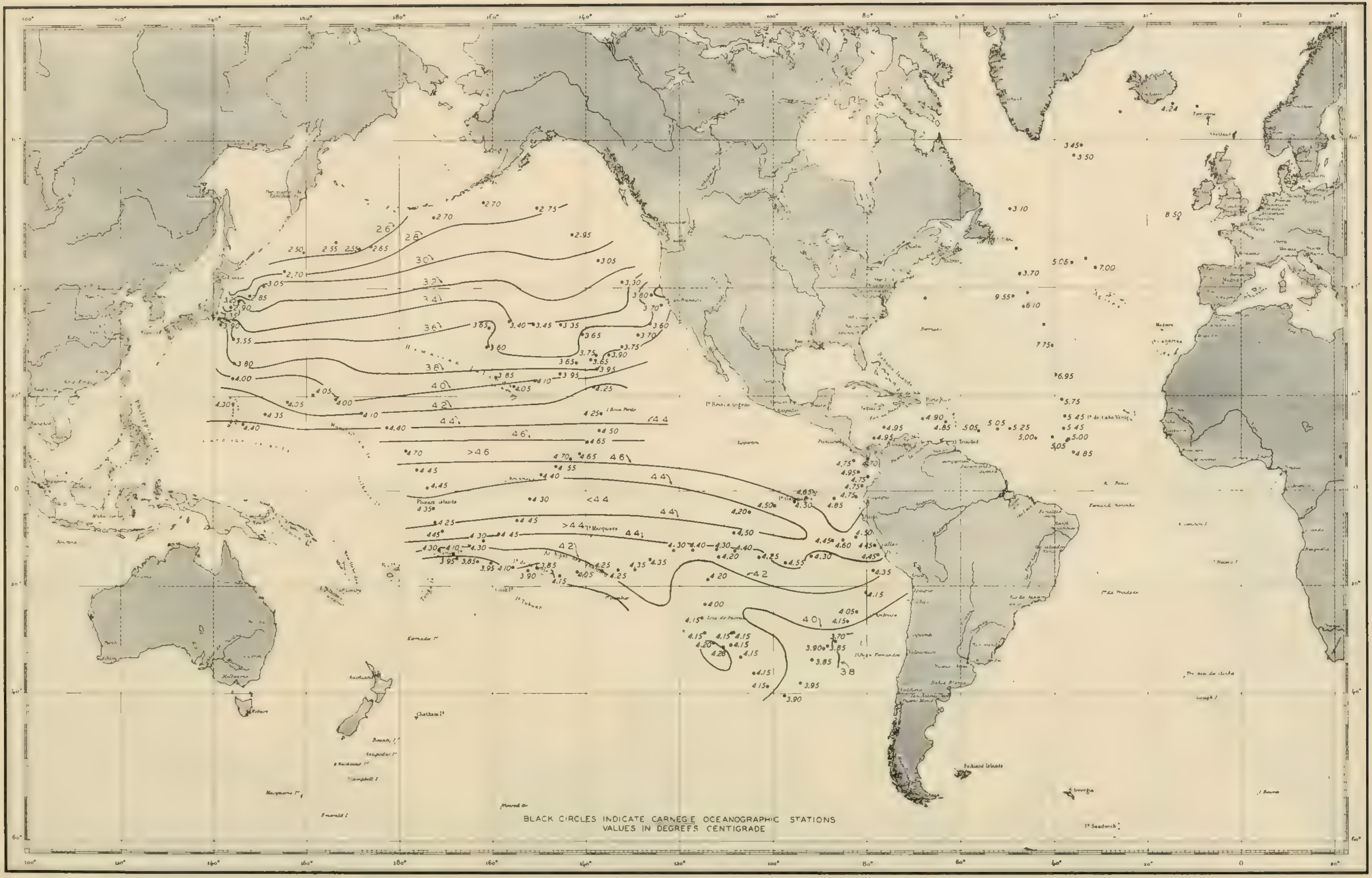


FIG. 217—HORIZONTAL DISTRIBUTION TEMPERATURE AT 1000 METERS, FROM CARNEGIE RESULTS, 1928-1929

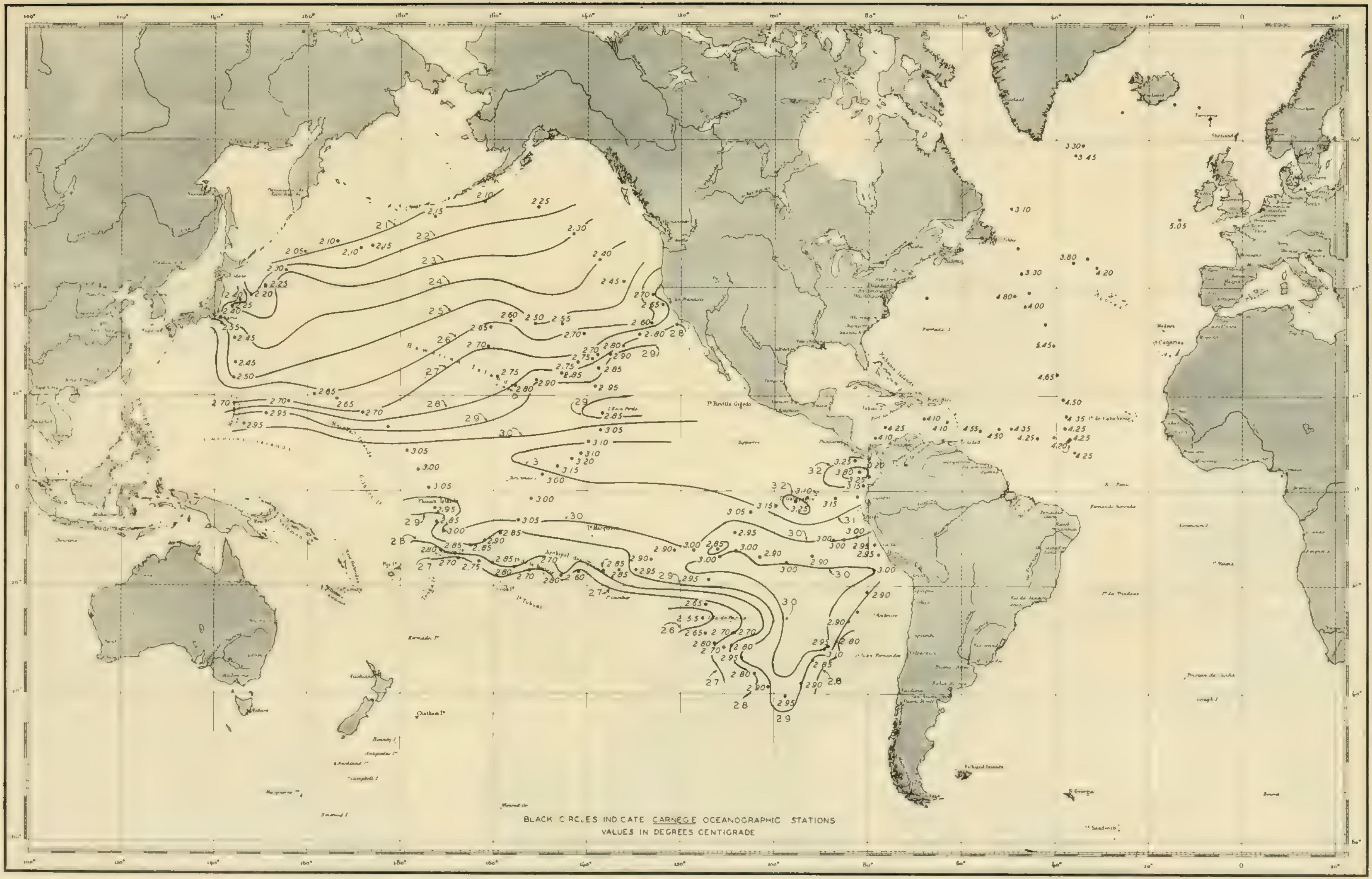


FIG. 218—HORIZONTAL DISTRIBUTION. TEMPERATURE AT 1500 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG 219—HORIZONTAL DISTRIBUTION TEMPERATURE AT 2000 METERS, FROM CARNEGIE RESULTS, 1928–1929

FIG. 220—HORIZONTAL DISTRIBUTION TEMPERATURE AT 2500 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 221—HORIZONTAL DISTRIBUTION TEMPERATURE AT 3000 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 222—HORIZONTAL DISTRIBUTION SALINITY AT SURFACE, FROM CARNEGIE RESULTS, 1928–1929

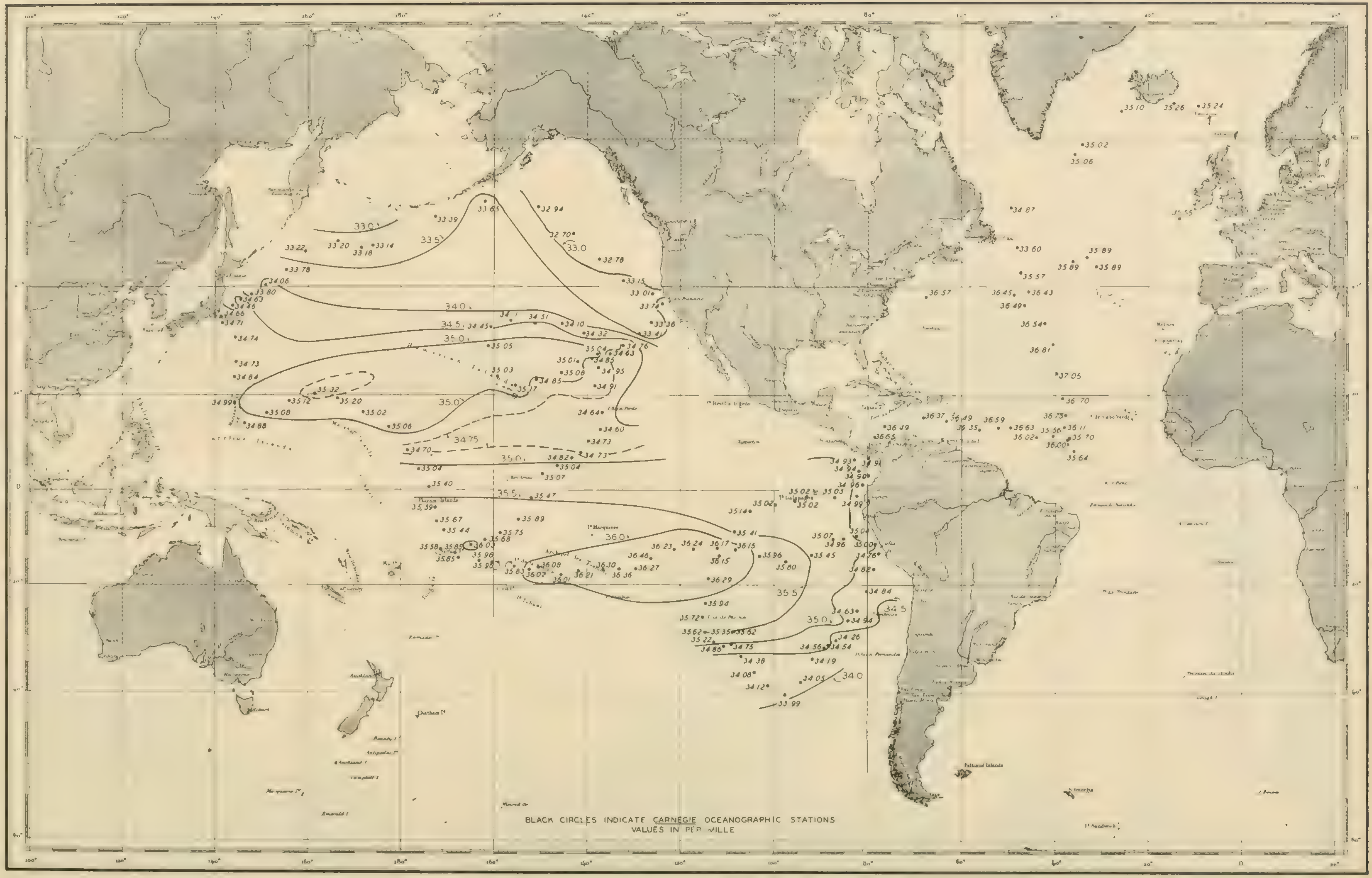


FIG. 223—HORIZONTAL DISTRIBUTION SALINITY AT 100 METERS, FROM CARNEGIE RESULTS, 1928-1929

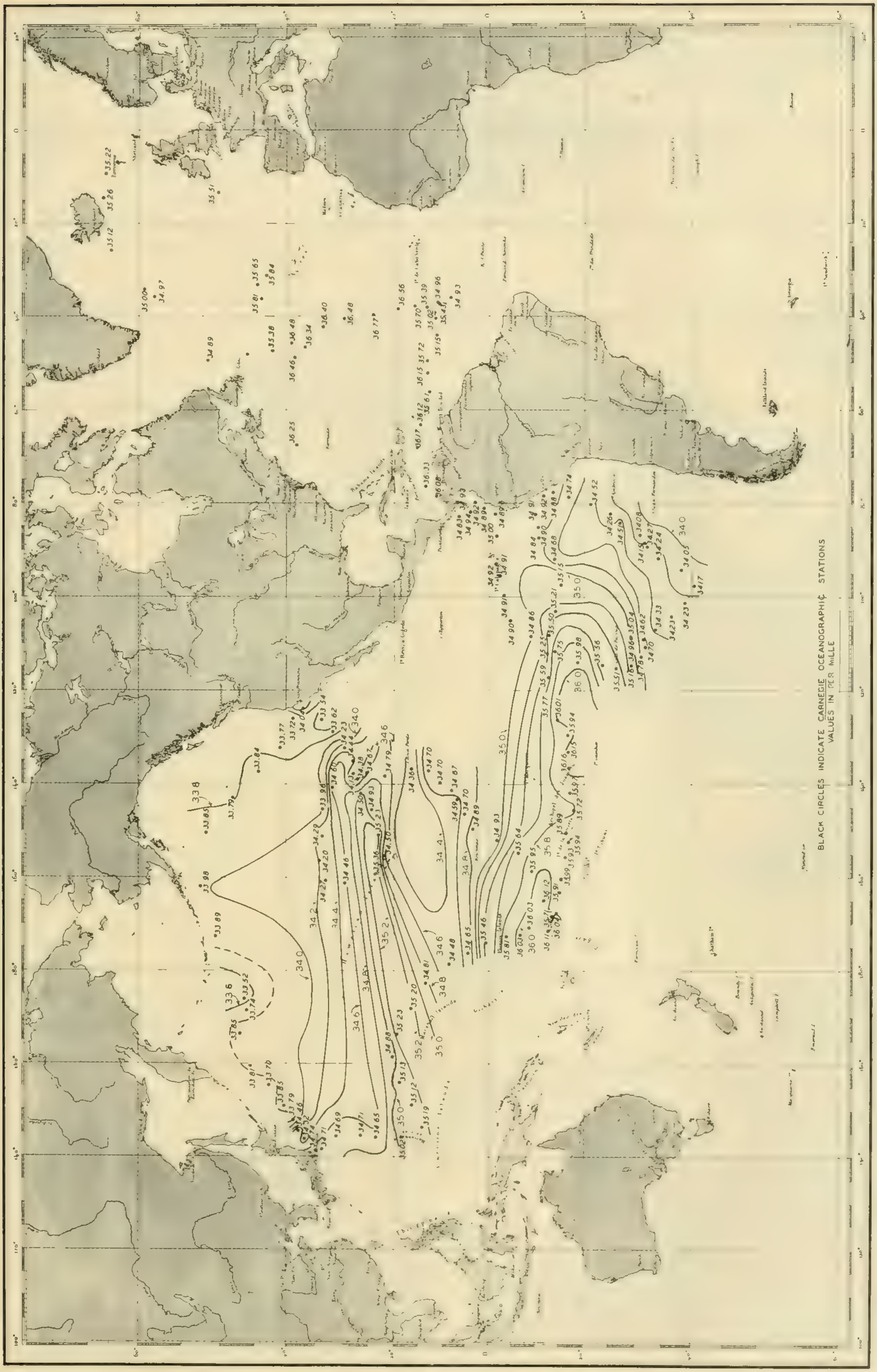


FIG. 224—HORIZONTAL DISTRIBUTION SALINITY AT 200 METERS, FROM CARNEGIE RESULTS, 1928-1929

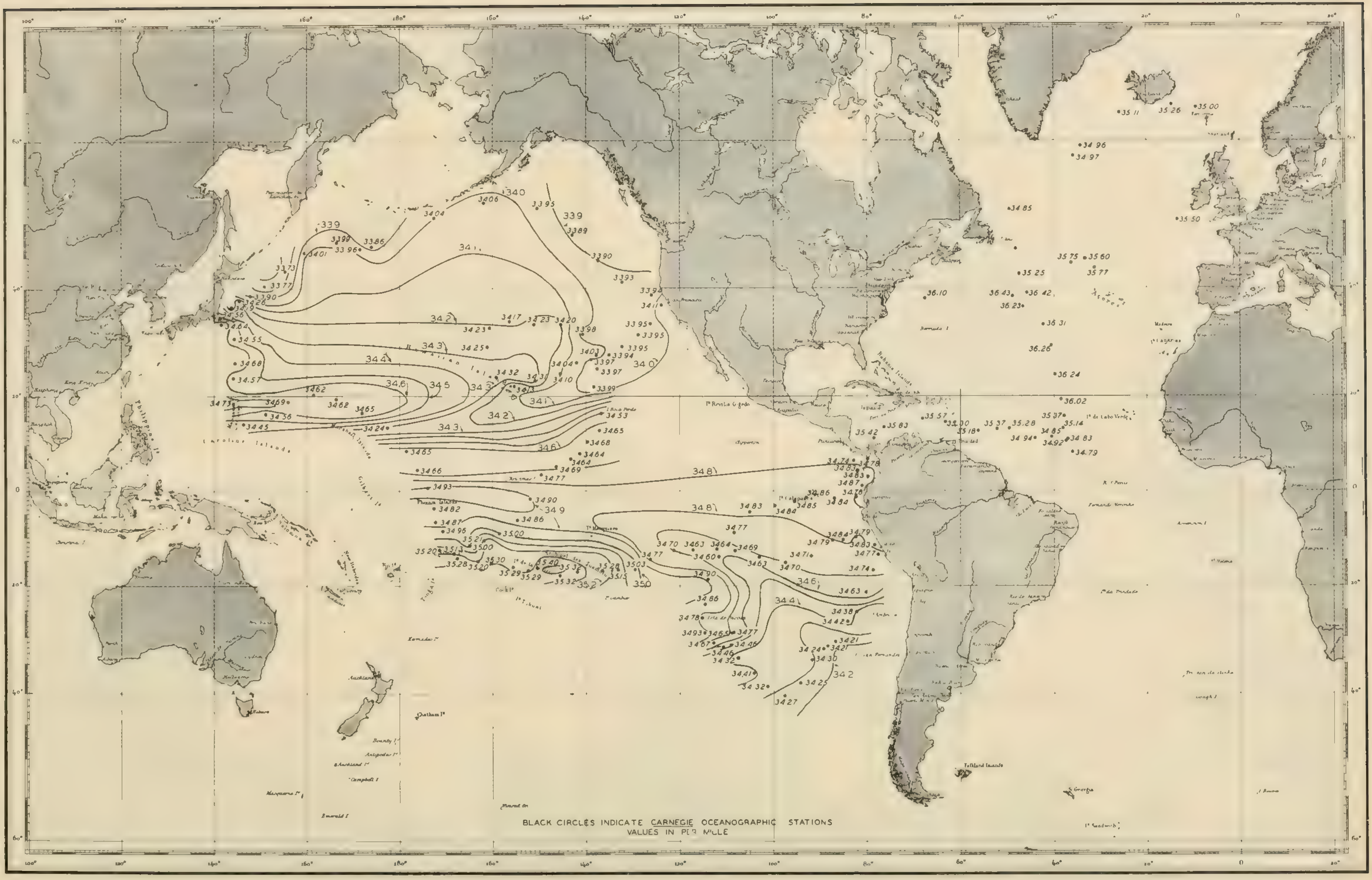


FIG. 225—HORIZONTAL DISTRIBUTION SALINITY AT 300 METERS, FROM CARNEGIE RESULTS, 1928–1929

FIG. 226—HORIZONTAL DISTRIBUTION SALINITY AT 400 METERS, FROM CARNEGIE RESULTS, 1928–1929

FIG. 227—HORIZONTAL DISTRIBUTION SALINITY AT 500 METERS, FROM CARNEGIE RESULTS, 1928–1929

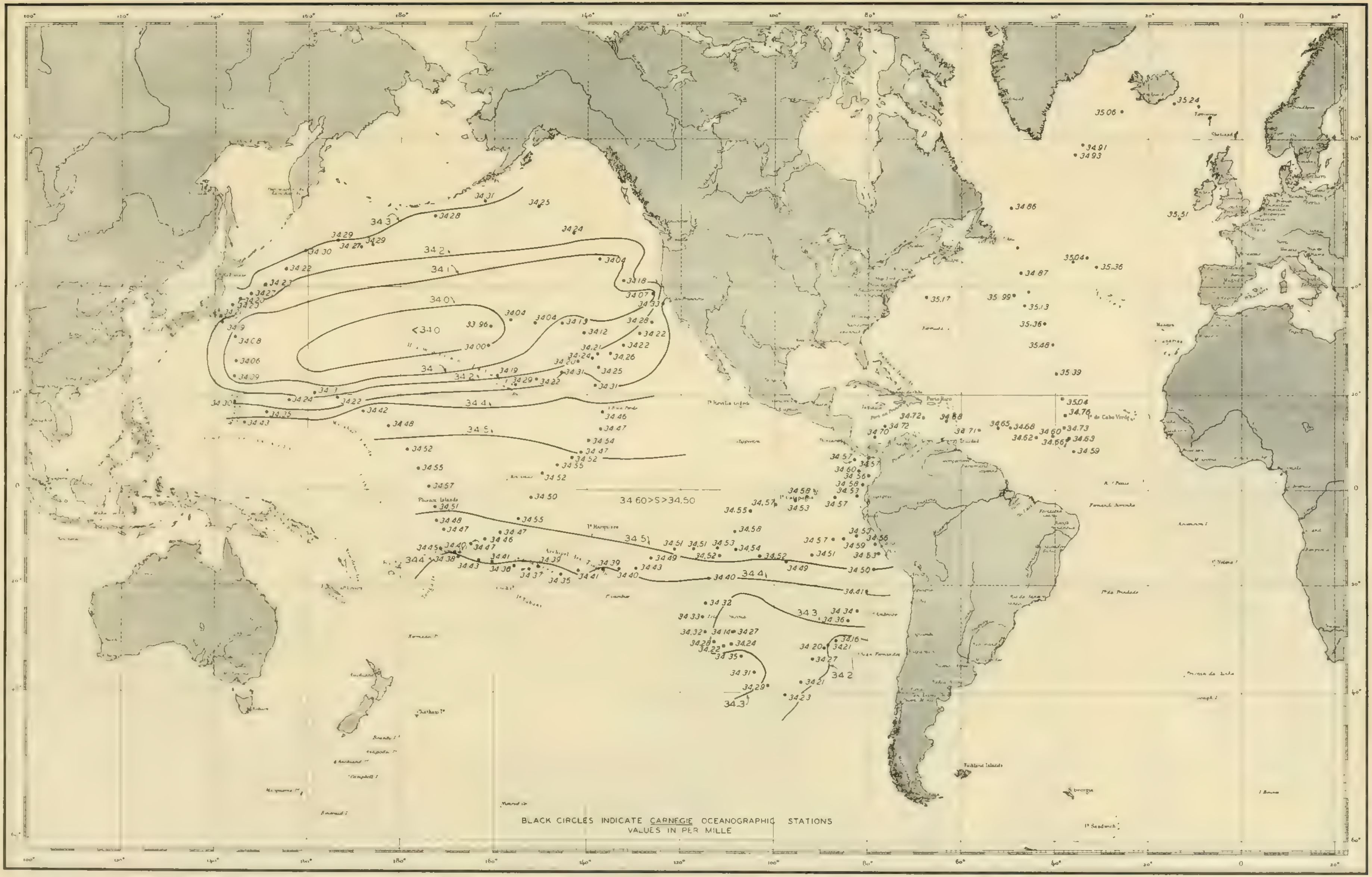


FIG. 228—HORIZONTAL DISTRIBUTION SALINITY AT 700 METERS, FROM CARNEGIE RESULTS, 1928-1929

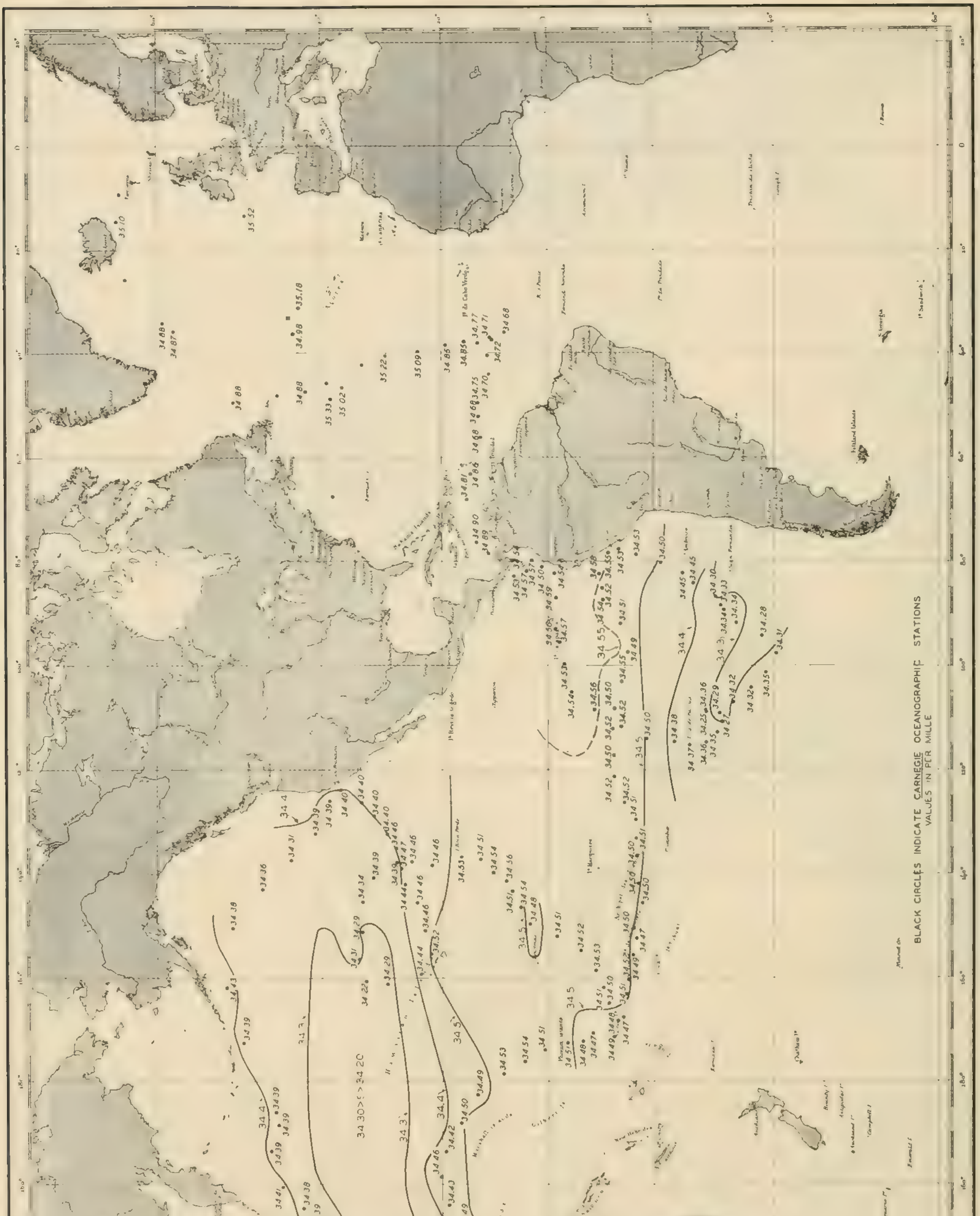


FIG. 229—HORIZONTAL DISTRIBUTION SALINITY AT 1000 METERS, FROM CARNEGIE RESULTS 1928-1929

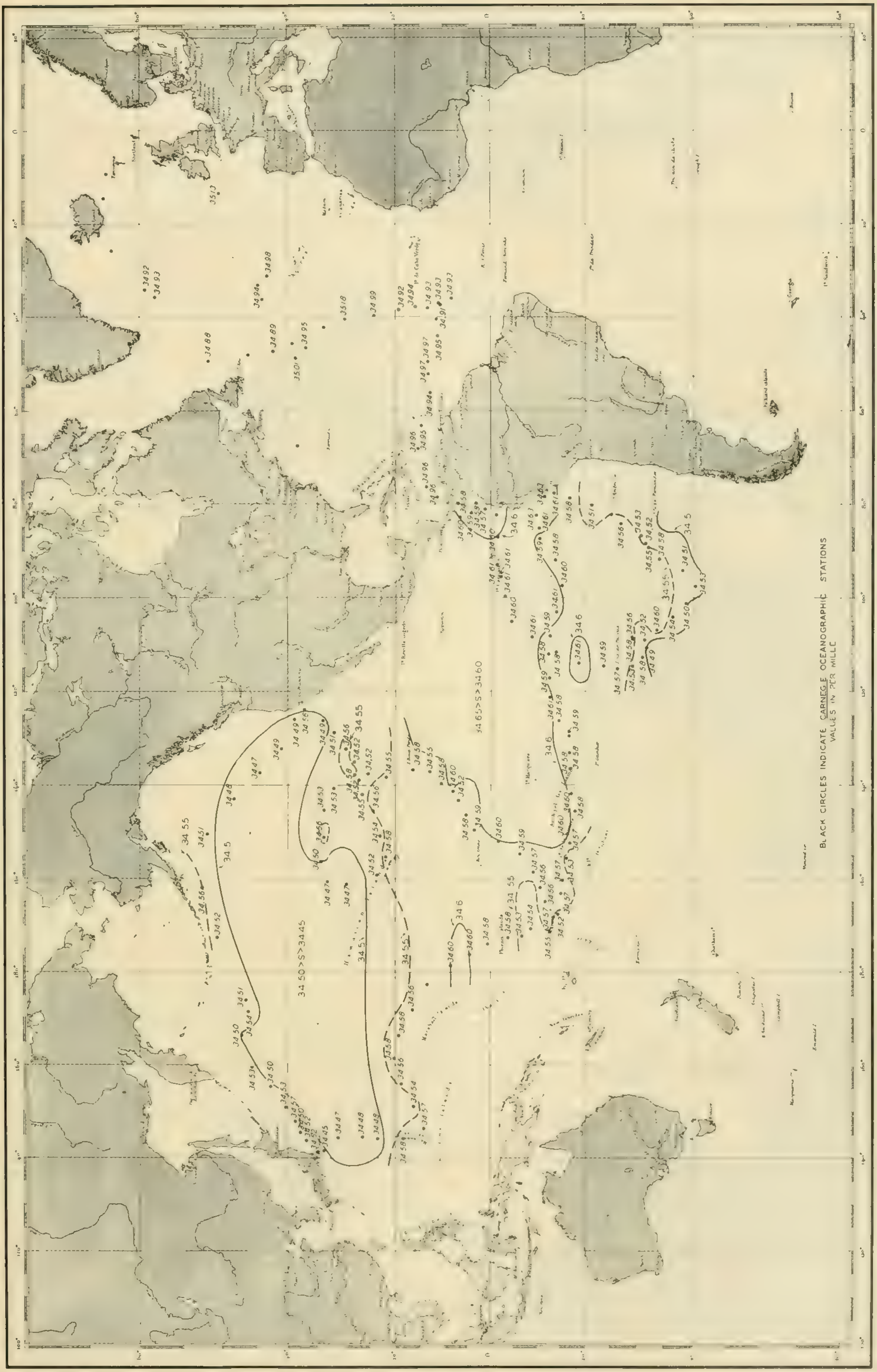


FIG. 230—HORIZONTAL DISTRIBUTION SALINITY AT 1500 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 231—HORIZONTAL DISTRIBUTION SALINITY AT 2000 METERS, FROM CARNEGIE RESULTS, 1928–1929

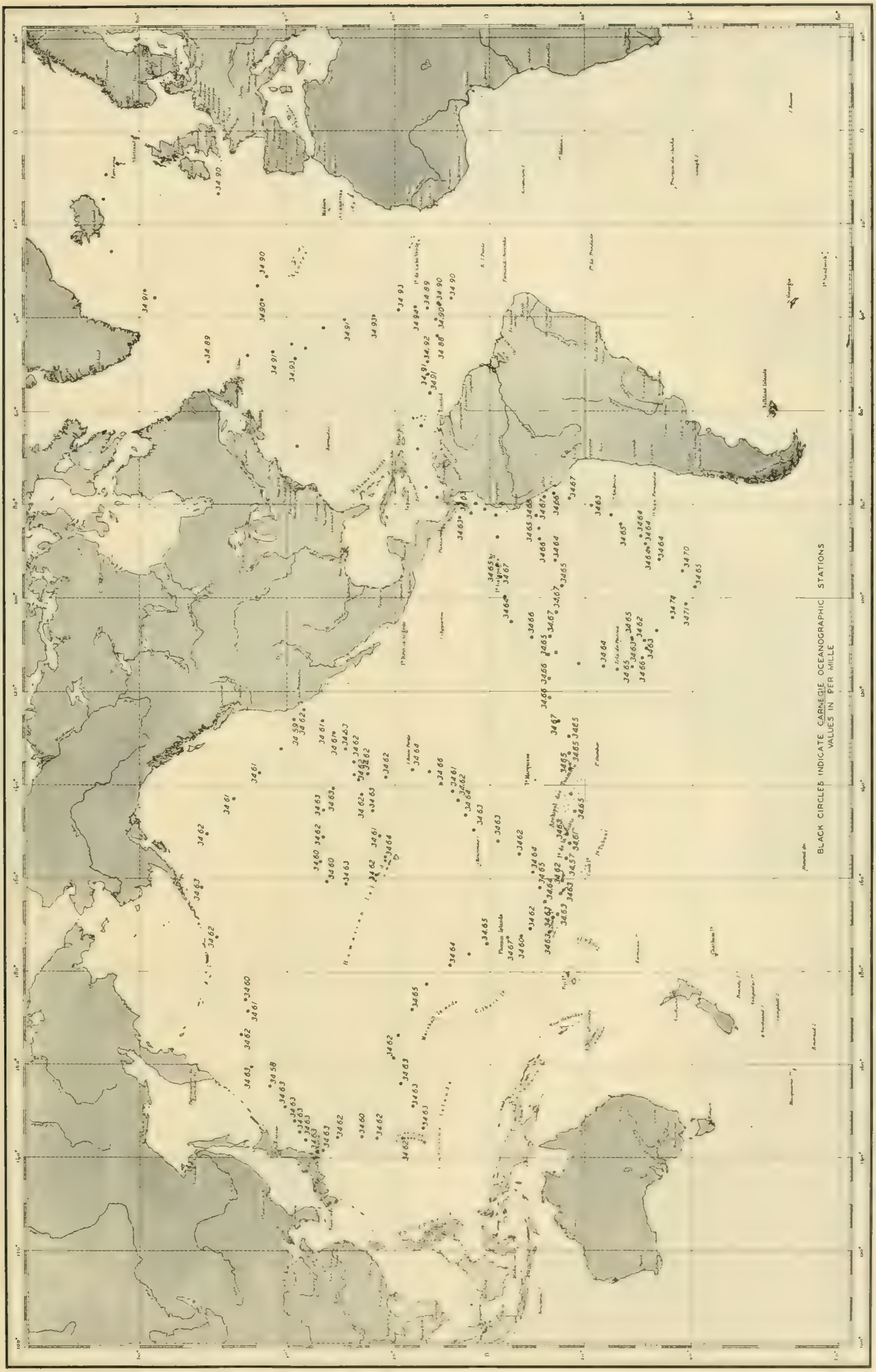


FIG. 232—HORIZONTAL DISTRIBUTION SALINITY AT 2500 METERS FROM CARNEGIE RESULTS, 1928–1929

FIG. 233—HORIZONTAL DISTRIBUTION SALINITY AT 3000 METERS, FROM CARNEGIE RESULTS, 1928–1929

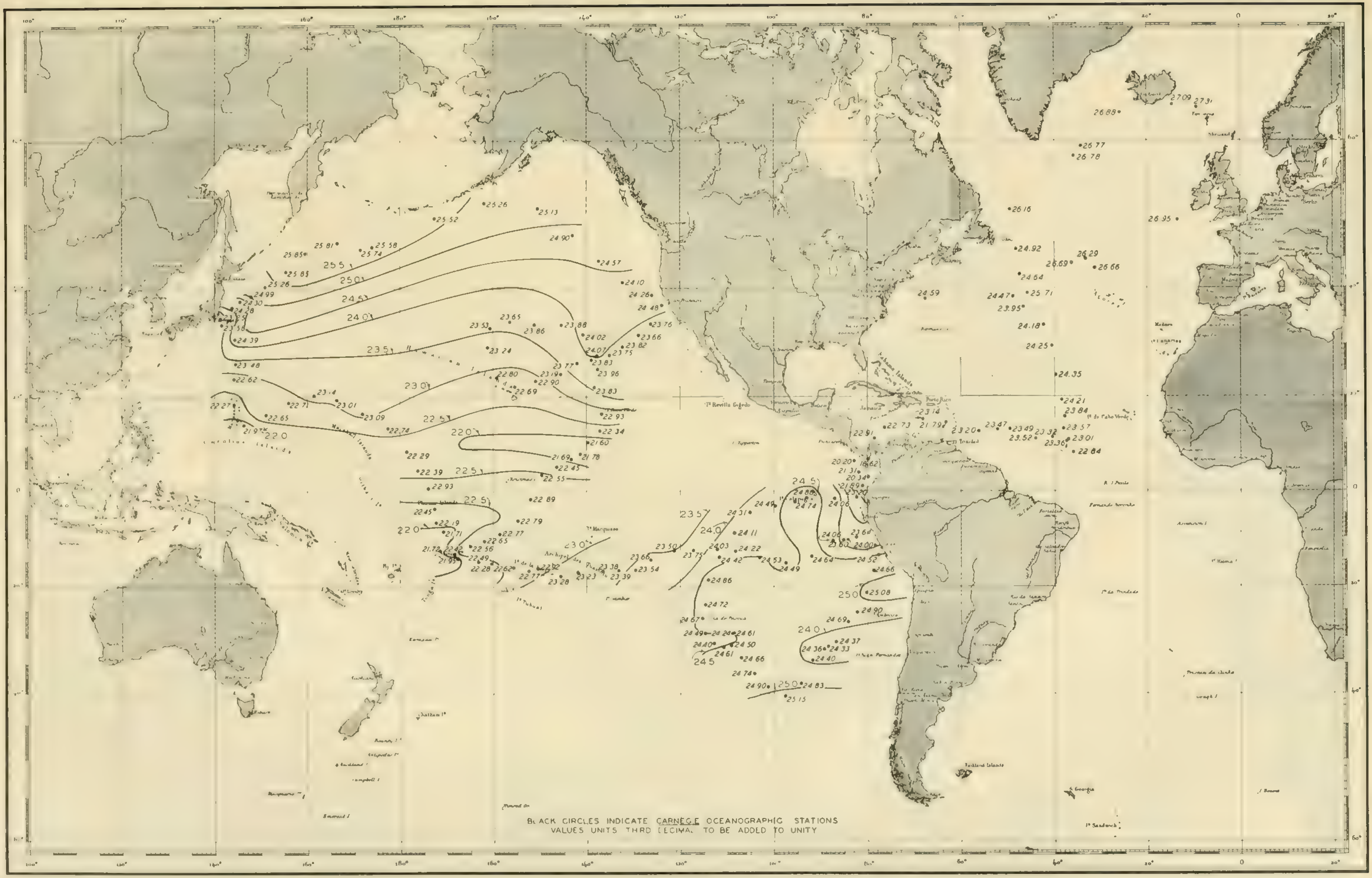


FIG. 234—HORIZONTAL DISTRIBUTION DENSITY AT SURFACE, FROM CARNEGIE RESULTS, 1928-1929

FIG. 235—HORIZONTAL DISTRIBUTION DENSITY AT 100 METERS, FROM CARNEGIE RESULTS, 1928-1929

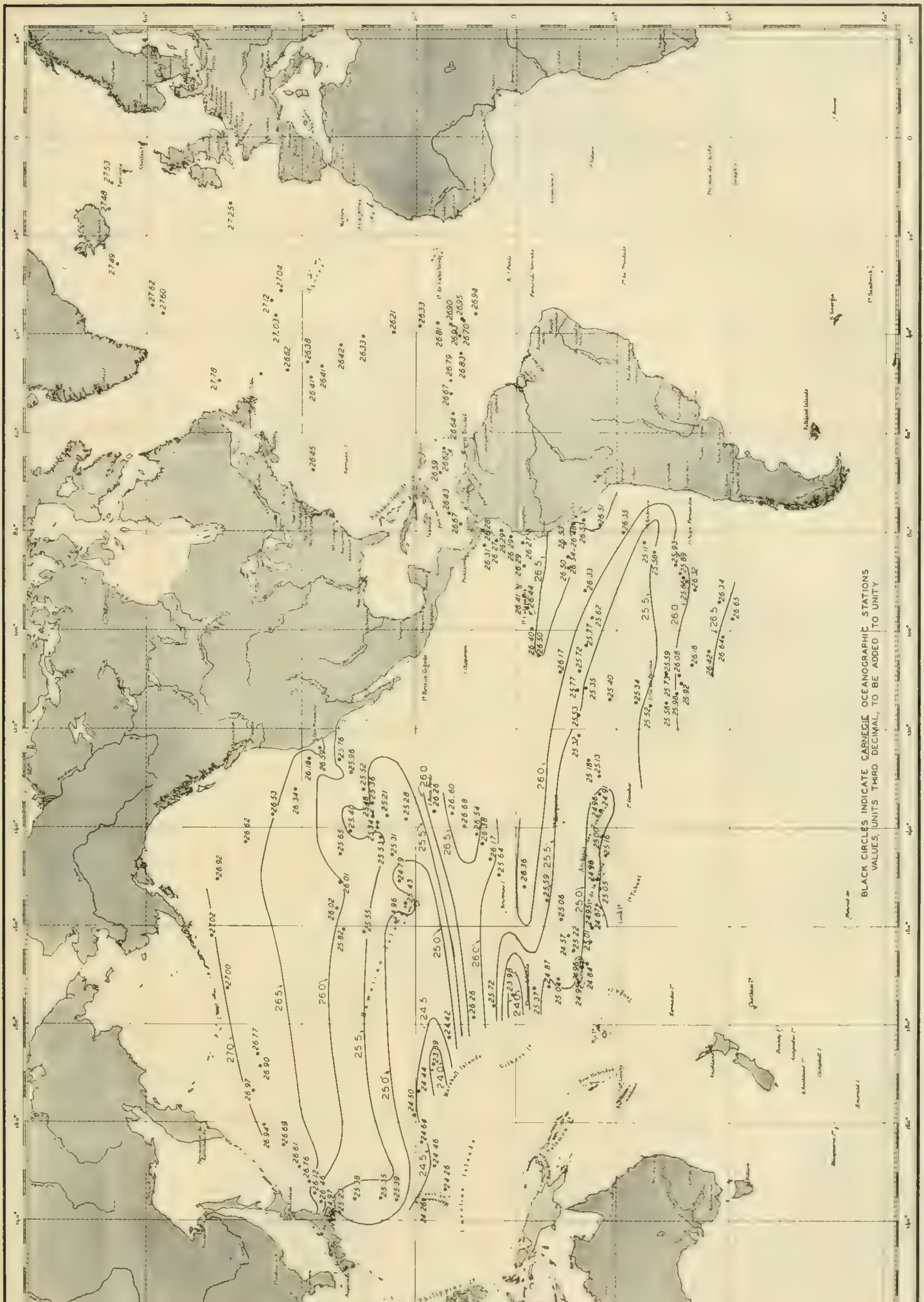


FIG. 236—HORIZONTAL DISTRIBUTION DENSITY AT 200 METERS, FROM CARNEGIE RESULTS, 1928–1929

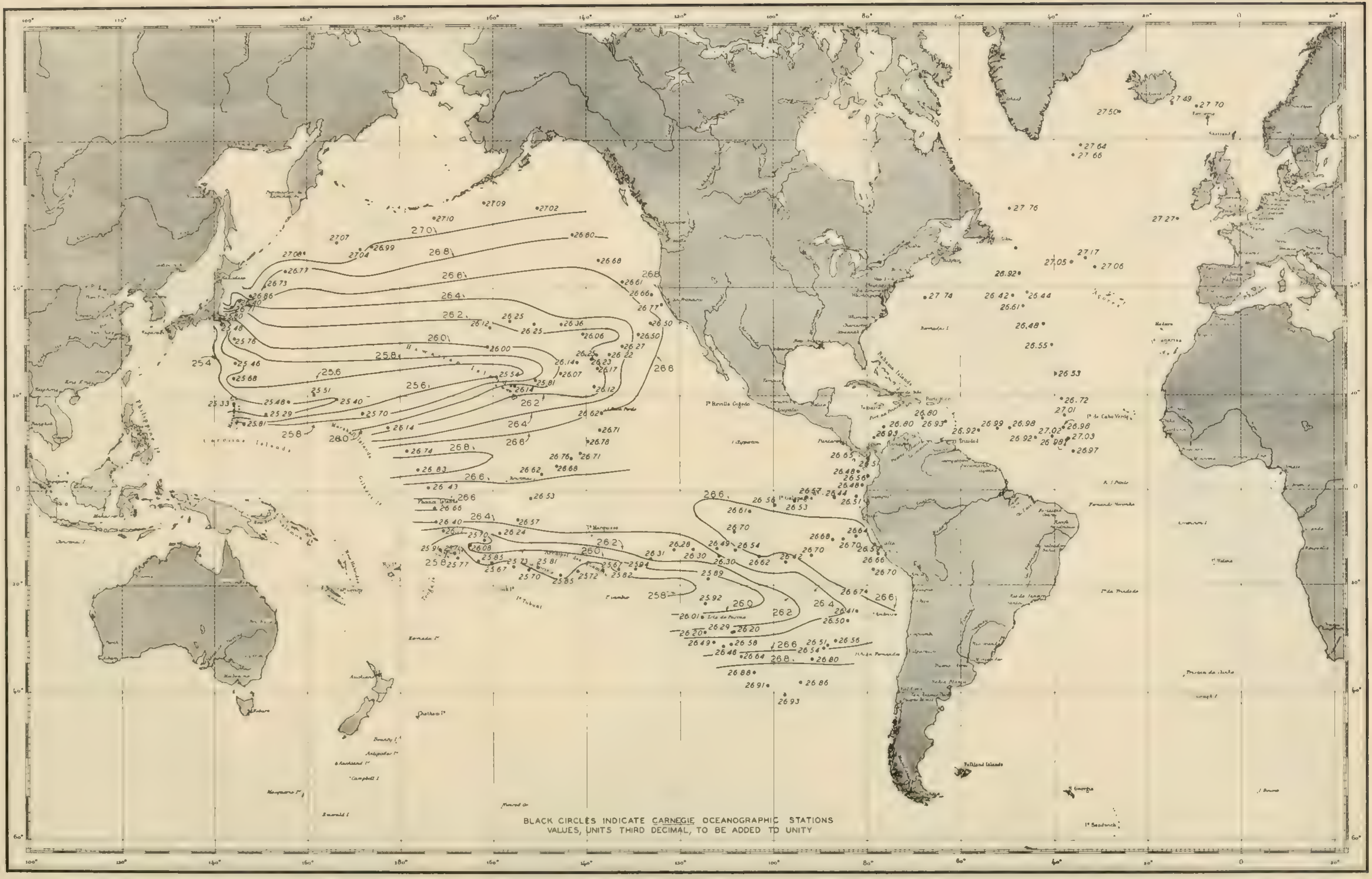


FIG. 237—HORIZONTAL DISTRIBUTION DENSITY AT 300 METERS, FROM CARNEGIE RESULTS, 1928-1929

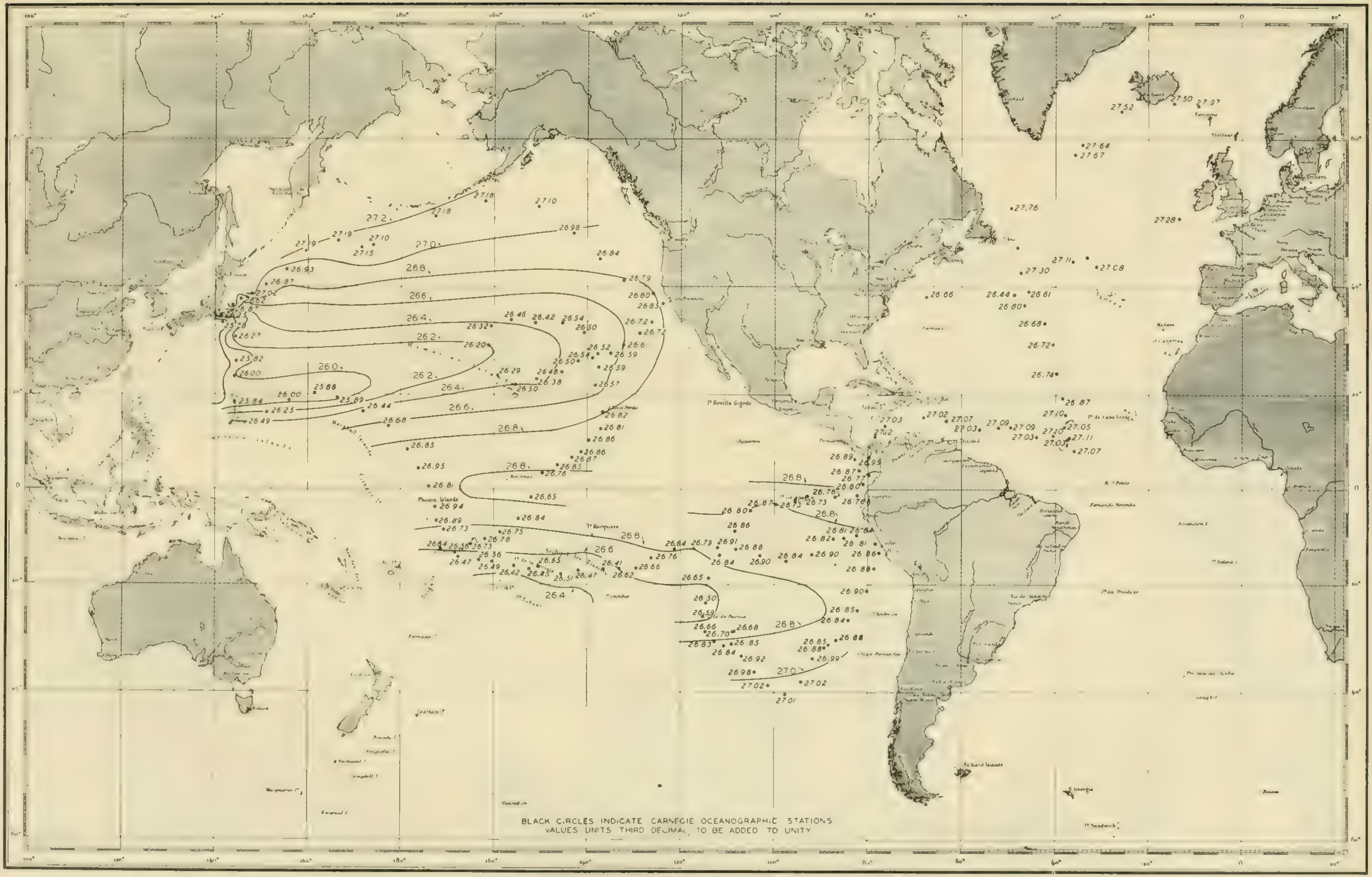


FIG. 238—HORIZONTAL DISTRIBUTION DENSITY AT 400 METERS FROM CARNEGIE RESULTS 1928–1929

FIG. 239—HORIZONTAL DISTRIBUTION DENSITY AT 500 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 240—HORIZONTAL DISTRIBUTION DENSITY AT 700 METERS, FROM CARNEGIE RESULTS, 1928–1929

FIG. 241—HORIZONTAL DISTRIBUTION DENSITY AT 1000 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 242—HORIZONTAL DISTRIBUTION DENSITY AT 1500 METERS, FROM CARNEGIE RESULTS, 1928–1929

FIG. 243—HORIZONTAL DISTRIBUTION DENSITY AT 2000 METERS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 244—HORIZONTAL DISTRIBUTION DENSITY AT 2500 METERS, FROM CARNEGIE RESULTS, 1928-1929

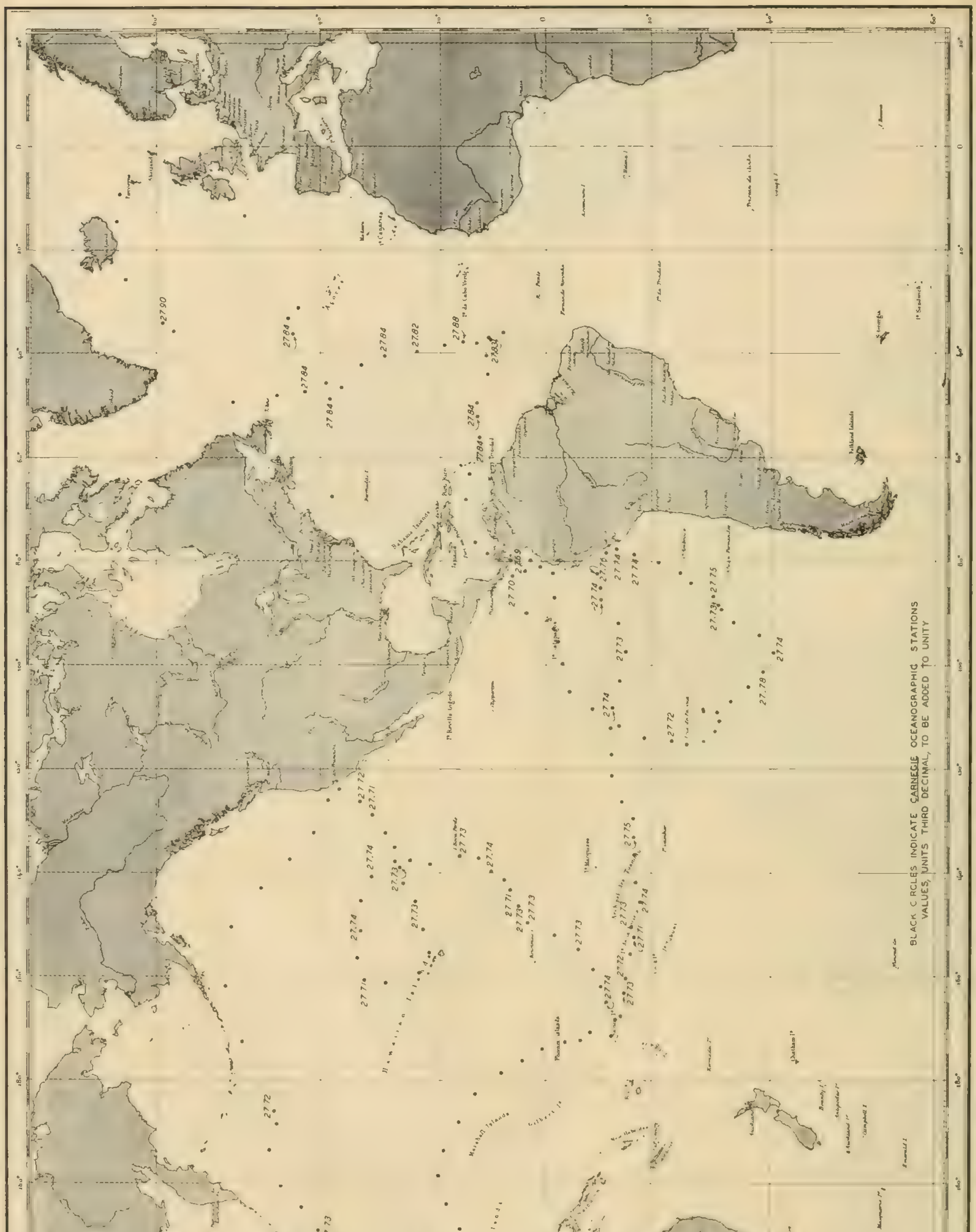


FIG. 245—HORIZONTAL DISTRIBUTION DENSITY AT 3000 METERS, FROM CARNEGIE RESULTS, 1928-1929

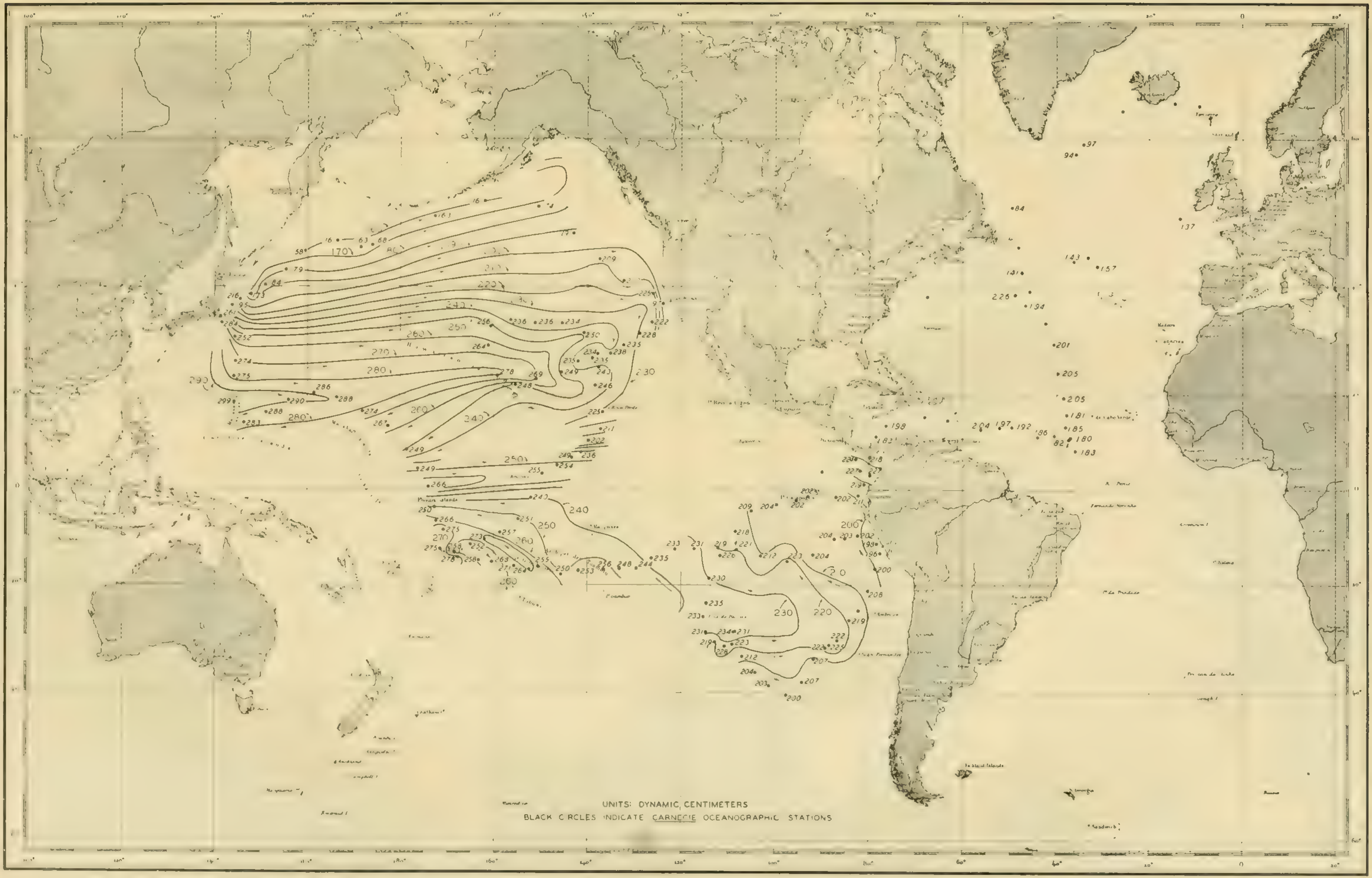


FIG 246—RELATIVE TOPOGRAPHY, 2000–0 DECIBARS, FROM CARNEGIE RESULTS 1928-1929

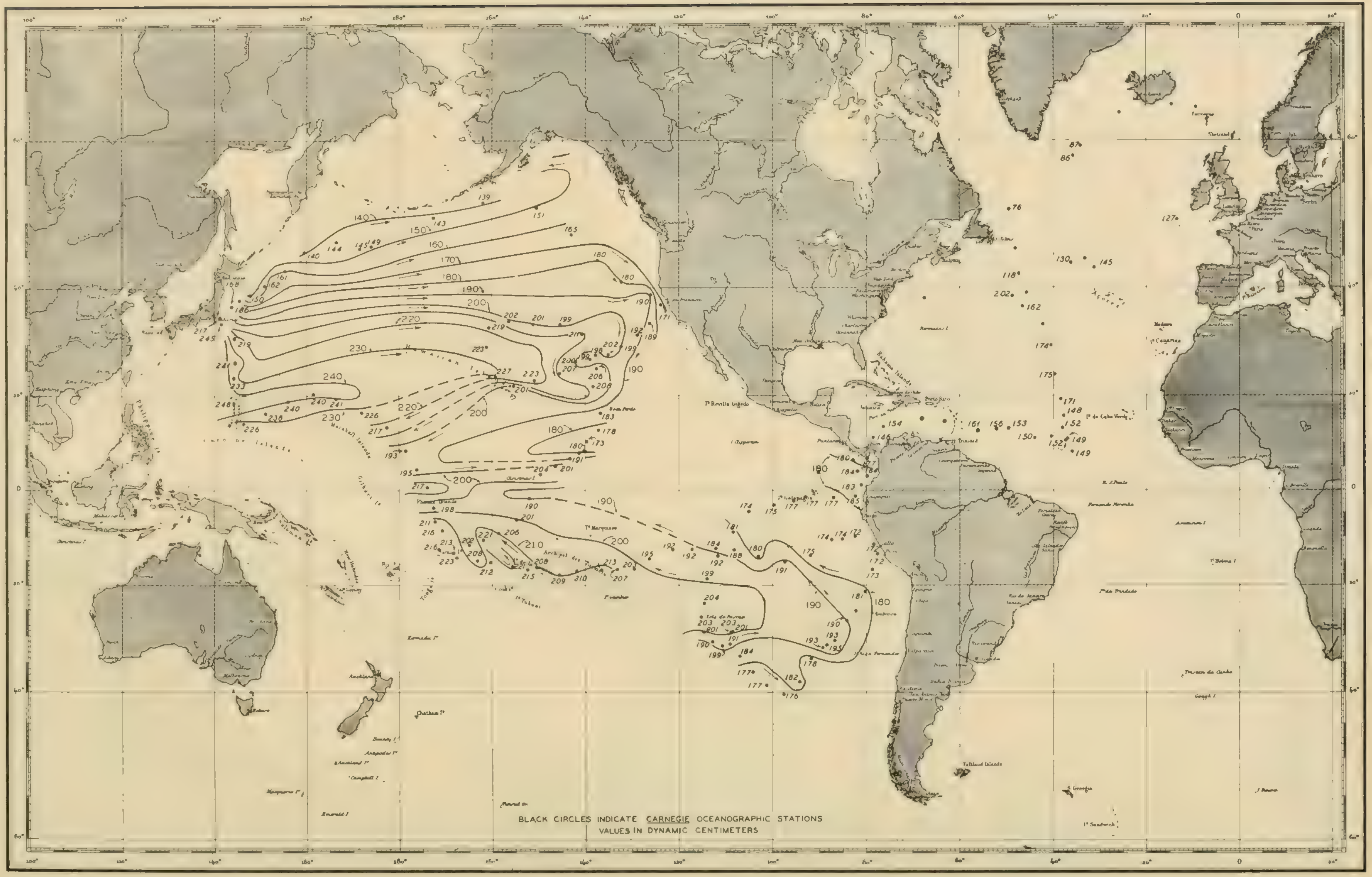


FIG. 247—RELATIVE TOPOGRAPHY, 2000-100 DECIBARS, FROM CARNEGIE RESULTS, 1928-1929

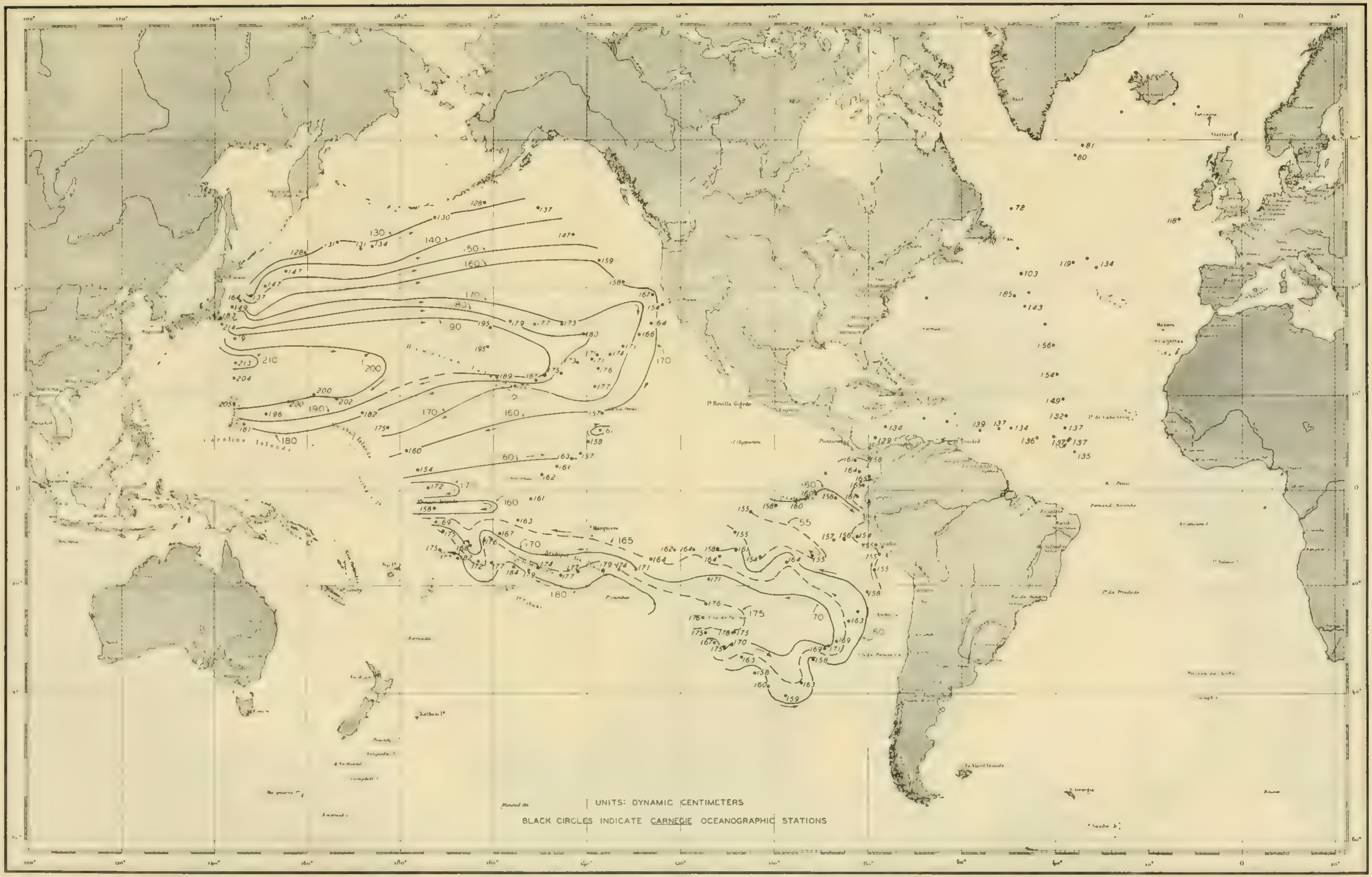


FIG. 248—RELATIVE TOPOGRAPHY 2000–200 DECIBARS, FROM CARNEGIE RESULTS, 1928–1929

FIG. 249—RELATIVE TOPOGRAPHY 2000-300 DECIBARS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 250—RELATIVE TOPOGRAPHY 2000—400 DECIBARS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 251—RELATIVE TOPOGRAPHY 2000–500 DECIBARS, FROM CARNEGIE RESULTS, 1928 - 1929

FIG. 252—RELATIVE TOPOGRAPHY 2000-700 DECIBARS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 253—RELATIVE TOPOGRAPHY, 2000–1000 DECIBARS, FROM CARNEGIE RESULTS, 1928-1929

FIG. 254—RELATIVE TOPOGRAPHY 2000–1500 DECIBARS, FROM CARNEGIE RESULTS, 1928–1929

TABLES 1 TO 5

After completion of the computations for the results of this table, it was found that the values of salinity of the deep water between 34.6 and 35.0 are about 0.03 per mille too low. This correction should be borne in mind in utilizing the tabular values (see Oceanography 1-A)

Table 1. Hourly values of sea-surface

Values are thermogram readings

Date	Latitude	Longitude east	Values in °C,										
			00	01	02	03	04	05	06	07	08	09	10
1928	°	°											
May 18	39.2 N	314.4	18.4	20.0	20.3	20.0	20.2	19.9	20.2	20.4	20.4	20.4	20.6
19	40.6 N	318.2	17.5	17.9	17.2	16.0	15.9	15.6	15.9	16.0	16.0	16.2	16.2
20	42.0 N	321.2	16.1	15.9	16.0	16.1	16.0	15.9	15.6	15.7	15.4	15.5	15.2
21	44.0 N	324.0	14.9	15.0	14.7	14.7	14.8	14.9	14.6	15.0	15.1	15.2	15.3
22[a]	45.5 N	326.7	15.5	15.6	15.9	15.5	15.9	15.0	14.4	14.8	14.9	14.4	14.0
23	45.0 N	326.9	15.5	15.5	15.6	15.1	15.1	15.0	15.0	14.9	14.6	14.6	14.6
24	43.9 N	328.4	15.2	15.4	15.5	15.6	15.3	15.1	15.8	16.0	16.1	16.1	16.0
25	43.2 N	328.6	15.2	15.2	15.0	15.0	15.0	15.0	14.9	14.9	15.0	15.0	15.3
26[b]	44.0 N	331.6	15.6	15.5	15.5	15.0	14.8	14.8	14.8	14.9	15.3	14.3	14.3
27	45.8 N	334.5	13.9	13.9	13.9	13.8	13.9	13.9	13.9	13.7	13.6	13.6	13.8
28	48.2 N	338.9	13.4	13.4	13.4	13.4	13.3	13.1	12.9	13.0	13.5	13.2	13.1
29	48.8 N	341.2	12.6	12.5	12.5	12.8	12.6	12.5	12.5	12.6	12.9	12.9	13.0
June 1	50.0 N	346.9	12.5	12.5	12.4	12.4	12.4	12.4	12.4	12.4	12.5	12.6	12.6
2	49.5 N	348.0	13.2	12.8	13.6	13.1	13.1	13.1	13.2	13.2	13.2	13.1	13.2
3	50.2 N	347.4	12.9	12.8	12.7	12.7	12.6	12.6	12.6	12.7	12.7	12.6	12.5
4	50.5 N	347.7	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.4	12.4	12.5	12.7
5	49.9 N	348.9	12.5	12.6	12.6	12.5	12.7	12.7	12.7	12.6	12.6	12.6	12.8
6	50.2 N	350.0	12.7	12.6	12.6	12.8	12.8	12.8	12.9	12.7	12.6	12.7	12.9
7	50.2 N	352.0	12.9	12.9	12.6	12.6	12.7	12.6	12.6	12.7	12.8	12.8	12.9
8[c]	50.0 N	354.9	13.1	13.1	13.1	13.1	12.9	12.9	12.8	12.9	13.1	12.4	12.3
19	50.5 N	359.0	12.4	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.4	12.5	12.8
20	51.7 N	2.3	12.6	12.4	12.4	12.8	12.8	12.6	12.6	12.6	12.5	12.6	12.9
21[c]	53.4 N	4.4	12.3	12.3	12.3	12.4	12.3	12.3	12.4	12.5	12.5	12.5	12.6
July 8[d]	54.1 N	7.6	15.5	15.4	15.2	15.3	15.1	15.0	14.6	14.5	13.9	13.5	13.5
11	60.5 N	0.3	11.3	11.3	11.2	11.2	11.2	11.2	11.2	11.2	11.1	10.8	10.8
12	62.3 N	355.0	10.4	10.4	10.4	10.4	10.4	10.4	9.5	9.5	9.6	9.7	9.7
13	63.3 N	350.6	9.7	9.9	10.0	9.6	9.5	9.5	9.7	9.6	9.8	10.0	9.7
14[e]	64.1 N	348.6	9.3	9.4	9.4	9.1	8.9	8.0	6.9	8.4	9.1	9.3	9.5
15[f]	63.5 N	345.2	9.9	9.9	9.9	9.9	10.1	10.2	10.2	10.2	10.6	10.8	10.9
16	63.3 N	342.6	10.6	10.6	10.5	10.6	10.6	10.5	10.7	11.0	11.4	11.5	11.3
17	63.0 N	341.4	11.2	11.2	11.2	10.8	11.2	11.3	11.3	11.2	11.3	11.5	11.6
18	62.6 N	340.0	11.7	11.8	11.7	11.7	11.7	11.7	11.8	11.8	11.7	11.7	11.7
19[g]	63.6 N	338.0	11.9	12.2	12.3	12.3	12.1	12.1	11.9	11.9	12.0	12.3	12.2
28[c]	62.5 N	333.7	10.5	11.1	11.3	11.4	11.4	11.2	11.0	11.1	11.2	11.1	11.1
29	60.7 N	328.8	11.5	11.5	11.5	11.4	11.4	11.4	11.0	11.3	11.4	11.2	11.5
30	59.3 N	325.8	10.8	10.8	11.1	11.0	11.0	11.1	11.2	11.2	11.0	11.1	11.1
31	57.9 N	325.6	11.0	11.0	10.8	10.9	11.1	11.1	11.1	10.9	10.9	10.9	11.3
Aug. 1	58.3 N	324.2	10.5	10.9	10.8	10.8	11.1	10.6	10.5	10.5	10.5	10.6	10.3
2	58.3 N	321.3	10.9	11.1	11.1	11.0	11.0	11.0	11.0	10.8	10.9	10.9	11.0
3	57.9 N	314.5	9.1	9.1	9.1	9.2	9.1	9.0	9.0	9.0	8.9	9.0	9.2
4	54.5 N	311.0	8.9	9.3	9.6	9.7	9.9	9.7	10.0	9.8	9.1	9.6	9.9
5	51.6 N	310.4	10.2	10.0	9.7	9.6	8.8	8.7	9.1	8.7	8.5	8.5	8.5
6	48.4 N	311.8	10.1	10.0	10.5	10.5	10.6	10.6	10.5	10.4	10.9	11.0	11.4
7[h]	45.9 N	312.1	11.5	12.1	12.2	12.3	12.3	11.9	11.7	11.3	10.8	11.3	11.2
8	43.2 N	313.0	17.7	17.5	17.5	17.1	16.7	16.1	16.7	16.5	16.5	15.7	15.1
9	42.2 N	312.7	20.8	21.0	21.1	21.3	21.3	21.3	21.3	21.1	21.1	21.1	21.6
10[i]	39.8 N	311.1	21.7	22.1	21.9	21.8	21.6	22.1	21.6	23.8	24.6	24.2	24.6
11	38.6 N	311.2	24.9	24.6	24.6	24.7	24.7	24.6	24.6	24.6	24.6	24.7	24.8
12	37.0 N	311.6	25.6	25.6	25.5	25.2	25.1	25.1	25.2	25.3	25.4	25.6	25.7
13	36.8 N	313.4	26.1	25.9	26.0	25.7	25.2	25.3	25.7	25.7	25.8	25.9	26.0
14	35.2 N	315.6	26.0	26.0	26.0	26.1	26.2	26.2	26.2	26.2	26.2	26.1	25.8
15	33.6 N	317.7	26.6	26.4	26.4	26.3	26.4	26.3	26.4	26.5	26.4	26.4	26.4
16	31.2 N	318.8	26.4	26.3	26.3	26.7	26.8	26.7	26.7	26.7	26.7	26.8	27.2
17	29.8 N	319.4	27.2	27.2	27.1	27.1	26.9	27.0	26.7	26.8	26.8	26.8	26.9
18	27.9 N	320.5	27.0	27.0	26.9	27.1	26.9	26.7	27.0	27.0	27.0	26.9	27.0
19	25.7 N	321.0	26.8	26.8	26.9	26.9	26.8	26.8	26.8	26.8	26.5	26.8	26.9
20	24.0 N	320.4	26.7	26.8	26.8	26.6	26.7	26.7	26.5	26.5	26.5	26.6	26.8
21	21.8 N	320.4	26.8	26.5	26.5	26.5	26.5	26.5	26.4	26.4	26.5	26.5	26.5
22	19.2 N	321.5	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	25.9	26.0
23	16.6 N	322.2	26.0	26.0	26.1	26.1	26.0	26.1	26.0	26.1	26.1	26.1	26.2
24[j]	15.8 N	322.1	26.3	26.2	26.2	26.2	26.2	26.2	26.2	26.3	26.5	26.6	27.0
27	13.4 N	322.0	26.9	26.7	26.7	26.7	26.6	26.7	26.6	26.6	26.6	26.7	27.0
28	11.9 N	322.2	27.0	26.9	27.0	27.2	27.2	27.2	27.2	27.2	27.2	27.3	27.7
29	10.8 N	322.6	27.2	27.4	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.3

[a] Small, rapid fluctuations in surface temperature morning hours; cloudy, moderate breeze. [b] Small, rapid fluctuations in surface temperature between 13h and 20h; cloudy, fresh. [c] Carnegie at Plymouth June 9-18; at Hamburg June 22-July 7; at Reykjavik July 20-27. [d] Gradual fall of 2°3 between 00h and 17h; leaving Helgoland. [e] Sharp fall and rise of 2° between 04h and 08h. Another sudden fall and rise of 1°5 between 14h and 17h; squalls during day. [f] Small, rapid fluctuations between 11h and 24h; partly cloudy

temperature, Carnegie, 1928-29

corrected from bucket readings

local mean hour 11	12	13	14	15	16	17	18	19	20	21	22	23	Mean
													°C
20.7	20.8	20.8	20.5	20.3	19.9	18.0	18.3	18.6	19.0	18.2	17.5	17.7	19.63
16.3	16.3	15.9	16.1	16.1	16.6	17.3	16.9	16.9	16.3	16.3	16.4	16.3	16.42
15.5	15.6	15.5	16.1	16.4	16.6	16.5	16.2	16.2	16.1	15.9	15.9	15.1	15.88
15.4	15.4	15.5	15.5	15.2	15.0	15.3	15.2	15.1	15.1	15.1	15.0	15.0	15.08
15.2	15.3	15.2	15.1	15.7	15.8	15.6	15.4	15.4	15.7	15.6	15.6	15.6	15.30
14.6	14.6	14.6	13.8	14.1	14.1	14.1	14.3	14.1	14.1	15.1	15.1	15.1	14.72
16.2	16.1	15.9	15.6	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.53
15.3	15.3	15.9	15.8	15.8	15.8	15.8	15.8	15.7	15.7	15.8	15.8	15.7	15.40
14.6	15.4	15.0	14.5	14.4	15.0	14.8	14.9	13.9	14.3	14.3	14.0	13.9	14.74
13.8	13.8	13.8	13.9	13.9	13.7	13.9	14.0	13.6	13.5	13.5	13.5	13.5	13.76
13.2	13.4	13.2	13.1	12.9	12.9	12.9	12.8	12.8	12.7	12.7	12.7	12.6	13.07
13.0	13.2	13.4	13.4	13.4	13.4	13.4	13.3	13.2	12.9	12.8	12.8	12.7	12.93
12.6	12.6	12.6	12.6	12.8	12.8	13.0	13.1	13.1	13.1	12.9	13.0	13.0	12.68
13.2	13.3	13.2	13.3	13.3	13.3	13.3	13.2	13.0	13.0	12.9	12.8	12.8	13.14
12.6	12.6	12.6	12.6	12.6	12.5	12.5	12.4	12.4	12.4	12.4	12.4	12.4	12.58
12.7	12.9	12.9	12.9	12.9	12.9	13.0	13.1	13.0	13.0	13.1	12.9	12.6	12.73
12.4	12.4	12.4	12.4	12.4	12.4	12.5	12.5	12.5	12.4	12.6	12.6	12.7	12.55
13.0	12.9	12.9	12.9	12.9	12.9	12.9	12.9	13.0	12.9	12.9	12.9	12.8	12.83
13.1	13.1	12.9	13.0	13.0	13.0	13.1	13.1	13.2	13.0	13.0	12.9	12.9	12.89
12.6	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	13.3	13.2	13.2	13.4	12.94
12.9	13.4	13.5	12.9	12.6	12.6	12.5	12.5	12.4	12.4	12.4	12.4	12.5	12.55
12.9	13.1	13.1	13.1	13.0	12.8	12.6	12.5	12.5	12.4	12.4	12.4	12.4	12.67
12.8	12.9	13.2	13.2	13.1	13.0	13.3	13.3	13.2	13.3	13.2	12.8	12.6	12.76
13.9	13.9	13.8	13.8	13.7	13.7	13.2	13.8	13.9	14.0	14.2	14.4	14.2	14.25
10.8	10.8	10.9	10.9	11.1	11.2	11.0	10.9	10.9	10.9	10.9	10.9	10.4	11.00
9.6	9.4	9.7	9.5	9.4	9.2	9.3	9.4	10.0	9.6	9.8	9.5	9.9	9.78
9.5	9.5	9.4	9.3	9.3	9.5	9.0	9.4	9.4	9.4	9.5	9.5	9.4	9.55
9.6	9.6	9.6	9.3	8.6	8.2	9.6	9.7	9.7	9.7	9.7	10.0	10.4	9.21
11.2	11.2	10.9	10.7	10.8	10.8	10.9	11.0	10.7	10.8	10.8	10.6	10.5	10.56
11.6	11.6	11.5	11.4	11.7	11.7	11.7	11.7	11.6	11.4	10.7	11.0	11.2	11.17
11.7	11.6	11.9	11.8	11.8	11.7	11.8	11.8	11.8	11.8	11.7	11.7	11.8	11.53
11.3	11.7	11.6	11.8	11.9	12.0	12.0	12.1	12.1	11.9	11.8	11.8	12.1	11.80
12.4	12.6	12.6	12.0	11.6	12.2	12.2	12.3	9.5	9.6	10.4	11.3	11.3	11.80
11.3	11.4	11.3	11.3	11.4	11.4	11.4	11.4	11.3	11.3	11.0	11.1	11.3	11.22
11.6	11.6	11.6	11.4	11.5	11.6	11.4	11.5	11.3	11.3	11.2	11.3	11.3	11.40
11.2	11.3	11.3	11.1	11.1	11.3	11.1	11.1	11.1	10.7	11.0	10.8	11.0	11.06
11.3	11.3	11.3	11.4	11.2	11.0	11.0	11.5	11.4	11.3	11.0	10.8	10.5	11.08
11.0	11.0	11.0	11.1	11.1	11.0	11.0	11.0	11.0	11.0	10.7	11.0	11.0	10.83
11.0	11.1	11.0	10.9	10.3	10.2	10.0	9.9	10.5	10.4	9.7	9.8	9.8	10.64
8.8	8.8	9.2	9.2	9.2	9.5	9.7	9.7	9.7	9.6	9.4	9.4	9.5	9.23
10.2	10.6	10.6	10.7	11.1	11.1	10.7	10.8	10.9	11.0	10.9	10.1	10.0	10.18
8.5	8.9	9.0	9.4	9.3	9.4	9.5	9.8	9.8	9.5	9.5	9.8	10.0	9.28
11.5	11.2	11.2	9.7	9.3	9.2	9.8	10.1	10.1	10.8	10.8	10.9	11.2	10.51
11.2	10.8	11.2	11.8	13.7	14.4	14.0	15.6	16.3	16.2	17.1	18.3	17.7	13.20
16.6	16.1	17.6	18.1	19.1	19.1	19.0	19.3	20.5	21.1	21.1	21.1	20.9	18.03
21.4	21.3	21.3	21.6	21.6	21.8	21.1	21.2	21.2	21.6	21.8	21.8	21.6	21.35
25.0	25.1	25.8	25.8	26.0	26.1	26.1	26.1	26.0	25.6	25.3	25.1	25.1	24.30
24.9	24.8	24.9	25.1	25.1	25.1	25.2	25.2	25.2	25.3	25.3	25.3	25.6	24.93
26.0	26.1	26.2	26.1	26.2	26.2	26.1	25.8	25.7	25.3	25.8	25.9	26.1	25.70
26.1	26.2	26.1	25.3	25.6	25.5	25.4	25.4	25.8	26.0	26.0	26.0	26.0	25.78
25.7	25.9	26.1	26.2	26.2	26.5	26.7	26.1	25.9	26.0	26.7	26.7	26.7	26.18
26.3	26.0	26.1	26.2	26.2	26.2	25.8	25.8	26.2	26.1	26.0	26.2	26.6	26.26
27.1	27.1	26.8	27.1	27.2	27.3	27.3	27.5	27.5	27.4	27.2	27.2	27.2	26.97
27.0	27.0	27.2	27.4	27.3	27.3	27.3	27.2	27.1	27.0	27.1	27.2	27.0	27.07
27.1	27.0	27.1	27.3	27.4	27.4	27.3	27.0	27.0	27.0	27.0	27.0	26.9	27.04
27.1	27.2	27.2	27.2	27.2	27.1	27.2	27.0	27.0	27.0	27.0	27.0	26.9	26.95
26.9	27.0	27.0	27.1	27.1	27.2	27.0	27.0	27.0	27.0	26.9	26.8	26.9	26.84
26.5	26.5	26.5	26.5	26.5	26.3	26.3	26.2	26.1	26.0	26.0	26.0	26.0	26.38
26.0	26.1	26.2	26.1	26.1	26.0	26.0	26.0	26.1	26.0	26.1	26.1	26.1	26.03
26.3	26.5	26.5	26.6	26.6	26.6	26.6	26.6	26.3	26.5	26.6	26.5	26.4	26.31
27.2	27.2	26.8	27.7	29.1	28.2	28.1	27.3	27.2	27.0	27.0	27.5	26.7	26.95
26.9	27.5	27.3	28.2	28.4	27.1	27.1	27.6	27.1	27.4	27.2	27.2	27.0	27.08
27.7	27.8	27.9	28.1	27.9	27.7	27.9	27.7	27.6	27.5	27.4	27.3	27.2	27.45
27.3	27.5	27.7	28.0	27.5	27.6	27.4	27.4	27.5	27.4	27.6	27.4	27.5	27.39

gentle breeze. [g] Sudden fall of 2°8 between 18h and 19h; approaching Reykjavik. [h] Very irregular fluctuations with rise of 7°5 between 12h and 20h; in boundary zone between Gulf Stream and Labrador Current; clear, moderate breeze. [i] Rapid rise in temperature of 3° with irregular fluctuations between 06h and 08h; entering Gulf Stream. [j] Small, rapid fluctuations in temperature between 10h and 18h; partly cloudy, calm to light airs.

Table 1. Hourly values of sea-surface

Date	Latitude	Longitude east	Values in °C,										
			00	01	02	03	04	05	06	07	08	09	10
1928	°	°											
Aug. 30	9.5 N	322.8	27.4	27.3	27.1	27.2	27.3	27.1	27.1	27.1	27.1	27.4	27.9
31	8.2 N	323.8	27.2	27.1	27.1	27.1	27.1	27.2	27.2	27.2	27.2	27.2	27.3
Sep. 1	9.4 N	323.3	27.1	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2
2	9.8 N	323.3	27.1	27.1	27.0	27.0	26.9	26.9	26.9	27.1	27.2	27.3	27.5
3	11.2 N	322.9	27.5	27.6	27.6	27.4	27.3	27.3	27.3	27.3	27.3	27.5	27.6
4	11.4 N	322.0	27.2	27.2	27.1	27.1	27.1	27.2	27.1	27.3	27.5	27.5	27.6
5	11.6 N	319.2	27.3	27.6	27.6	27.6	27.6	27.5	27.5	27.6	27.6	27.6	27.7
6	11.7 N	317.4	27.6	27.7	27.7	27.7	27.8	27.7	27.7	27.8	27.8	27.8	28.2
7	11.3 N	315.8	27.6	27.5	27.4	27.6	27.4	27.4	27.4	27.4	27.6	27.7	27.8
8	11.6 N	314.9	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.8	27.9
9	11.8 N	313.9	28.1	28.0	28.2	27.8	28.0	27.8	27.8	27.9	27.9	28.0	28.0
10	12.2 N	312.2	28.0	28.1	28.2	28.2	28.1	28.0	27.9	27.7	27.7	27.7	27.7
11	13.2 N	310.3	27.6	27.5	27.4	27.5	27.5	27.5	27.5	27.5	27.5	27.4	27.5
12	13.2 N	309.5	27.6	27.6	27.6	27.5	27.6	27.6	27.6	27.6	27.6	27.8	27.9
13	13.3 N	307.6	27.7	27.7	27.7	27.7	27.7	27.6	27.6	27.6	27.6	27.6	27.6
14	13.0 N	305.7	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.9	27.9
15	12.9 N	303.7	27.7	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.9	27.9	28.0
16	13.0 N	301.5	27.6	27.8	27.9	28.0	28.0	27.9	28.0	28.0	28.1	28.1	28.2
Oct. 2[a]	14.7 N	298.6	28.1	28.1	28.2	28.1	28.1	28.1	28.2	28.2	28.3	28.2	28.6
3	14.8 N	296.4	28.2	28.2	28.1	28.4	28.6	28.5	28.4	28.6	28.6	28.6	28.6
4	15.0 N	293.9	28.2	28.1	28.5	28.4	28.4	28.4	28.4	28.5	28.5	28.6	28.6
5	15.3 N	291.8	28.6	28.6	28.6	28.6	28.4	28.3	28.2	28.1	28.2	28.2	28.1
6	15.2 N	288.8	28.4	28.7	28.7	28.6	28.4	28.4	28.3	28.4	28.5	28.5	28.5
7	14.5 N	286.0	28.5	28.5	28.5	28.5	28.5	28.5	28.6	28.5	28.6	28.6	28.7
8	13.2 N	283.6	28.0	28.2	28.2	28.1	28.2	28.5	28.6	28.7	28.7	28.6	28.6
9	11.4 N	281.4	28.1	28.2	28.2	28.2	28.2	28.3	28.3	28.2	28.4	28.3	28.5
10	10.3 N	280.7	28.5	28.4	28.5	28.3	28.5	28.6	28.5	28.6	28.7	28.7	28.6
26[a]	6.7 N	280.1	28.1	27.9	27.7	27.7	27.6	27.6	27.6	27.7	27.5	27.6	27.5
27	5.7 N	279.9	27.2	27.2	27.2	27.2	27.2	27.1	27.2	27.1	26.8	27.1	27.1
28	4.3 N	280.2	26.7	26.8	26.9	26.7	26.7	26.7	26.7	26.9	26.9	26.9	26.9
29	4.1 N	280.1	26.7	26.7	26.7	26.7	26.7	26.7	26.6	26.6	26.6	26.9	27.1
30	2.9 N	279.9	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.6
31	4.5 N	278.1	26.4	26.4	26.4	26.4	26.4	26.5	26.6	26.6	26.7	26.7	26.8
Nov. 1	6.1 N	277.0	26.7	26.9	26.8	26.9	27.1	27.0	27.1	27.2	27.2	27.2	27.2
2	4.6 N	277.7	27.0	27.1	27.0	26.9	26.9	26.9	26.9	26.9	27.1	27.1	27.1
3	3.7 N	278.5	26.6	26.6	26.5	26.5	26.6	26.7	26.6	26.4	26.5	26.4	26.4
4	2.5 N	278.9	26.2	26.2	26.1	26.1	26.2	26.2	26.2	26.1	26.4	26.4	26.3
5	1.6 N	279.2	26.1	26.0	26.1	25.9	26.0	26.0	26.0	26.2	26.2	26.2	26.1
6	0.8 N	278.8	25.7	25.6	25.4	25.4	25.3	25.2	25.0	25.1	25.0	25.0	25.0
7	0.5 S	278.0	24.7	24.7	24.6	24.4	24.4	24.3	23.9	23.8	23.7	23.2	23.2
8	1.5 S	277.7	23.2	23.2	23.2	23.2	23.1	23.0	22.7	22.5	22.2	22.2	22.2
9	1.3 S	275.2	19.3	19.2	19.1	19.1	19.1	19.2	19.2	19.4	19.3	19.3	19.4
10	1.6 S	273.0	19.4	19.4	19.6	19.7	19.7	19.8	20.1	20.3	20.5	20.5	20.6
11	1.9 S	271.0	21.7	21.7	21.7	21.7	21.6	21.2	21.0	21.0	21.0	21.1	21.1
12[b]	1.3 S	268.7	19.4	19.5	19.5	19.5	19.3	19.1	18.9	19.0	19.2	19.3	19.3
13[c]	1.5 S	266.9	17.6	17.4	17.3	17.7	17.8	18.2	18.8	18.8	18.8	18.8	18.8
14	1.8 S	265.7	19.0	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.8	18.9
15	2.5 S	264.2	19.4	19.3	19.6	19.3	19.3	19.3	19.5	19.5	19.6	19.7	19.8
16	3.1 S	261.8	20.3	20.3	20.3	20.3	20.3	20.3	20.6	20.5	20.6	20.6	20.7
17	3.3 S	260.2	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.8	20.8	20.8
18	4.0 S	257.4	21.3	21.2	21.2	21.2	21.1	21.1	21.2	21.3	21.3	21.3	21.4
19	4.6 S	254.9	22.4	22.4	22.4	22.4	22.4	22.4	22.6	22.6	22.6	22.6	22.6
20	7.0 S	253.1	22.1	22.1	22.1	22.2	22.3	22.3	22.2	22.4	22.3	22.3	22.3
21	9.2 S	251.6	23.4	23.5	23.5	23.4	23.4	23.3	23.4	23.3	23.2	23.2	23.3
22	12.0 S	249.8	23.7	23.6	23.6	23.7	23.7	23.8	23.8	23.9	23.9	23.9	23.9
23	14.2 S	248.1	23.7	23.8	23.7	23.7	23.7	23.7	23.9	23.9	24.0	24.0	24.0
24	16.7 S	247.0	23.7	23.7	23.7	23.9	24.0	24.2	24.2	24.1	24.0	24.0	24.2
25	19.2 S	245.9	24.1	24.2	24.1	24.0	23.7	23.9	23.6	23.6	23.6	23.6	23.6
26	21.6 S	245.6	23.6	23.6	23.6	23.5	23.5	23.5	23.6	23.5	23.6	23.6	23.5
27	23.3 S	245.2	23.1	23.1	23.1	23.2	23.4	23.6	23.5	23.3	23.4	23.4	23.4
28	24.8 S	244.7	23.2	23.2	23.1	23.1	23.2	23.1	23.2	23.2	23.2	23.2	23.2
29	26.6 S	244.7	23.2	23.3	23.3	23.3	23.3	23.3	23.4	23.3	23.2	23.2	23.2
30	28.1 S	244.9	22.7	22.7	22.8	22.7	23.0	23.2	22.8	22.7	22.7	22.7	23.1
Dec. 1	29.2 S	245.2	23.0	22.7	22.7	22.7	22.7	22.8	22.9	22.8	22.8	22.9	23.0
7	30.6 S	245.7	22.4	22.7	22.7	22.7	22.7	22.9	22.8	22.6	22.4	22.4	22.7
13[d]	28.2 S	250.8	23.6	23.6	23.6	23.6	23.6	23.6	23.7	23.7	23.6	23.6	24.0
14	29.4 S	251.1	23.8	23.9	24.0	23.9	23.9	23.8	23.8	23.7	23.6	23.5	23.6
15	31.1 S	250.5	21.5	21.7	21.7	21.4	21.3	21.2	21.3	21.3	21.2	21.2	21.1

[a] Carnegie at Barbados September 16-October 1; at Balboa October 11-25. [b] Small, rapid fluctuations especially during midday hours; off Galapagos Islands; partly cloudy, gentle breeze. [c] Small, rapid

temperature, Carnegie, 1928-29--Continued

local mean hour													Mean
11	12	13	14	15	16	17	18	19	20	21	22	23	
													°C
27.9	27.7	27.7	27.7	27.7	27.6	27.5	27.5	27.4	27.3	27.2	27.2	27.2	27.40
27.4	27.3	27.3	27.5	27.5	27.4	27.3	27.2	27.4	27.2	27.2	27.2	27.2	27.25
27.4	27.4	27.2	27.2	27.2	27.2	27.2	27.2	27.1	26.9	27.0	27.1	27.1	27.18
27.6	27.6	27.7	27.5	27.4	27.5	27.5	27.6	27.6	27.6	27.7	27.5	27.5	27.35
27.6	27.6	28.0	27.8	27.6	27.7	27.5	27.4	27.4	27.3	27.2	27.2	27.2	27.47
27.6	27.7	27.8	27.9	27.9	27.8	27.8	27.6	27.6	27.6	27.5	27.5	27.4	27.48
27.8	27.8	27.8	28.0	27.9	28.0	27.8	27.8	27.8	27.7	27.4	27.5	27.5	27.67
28.2	28.2	28.3	28.0	28.3	28.2	28.2	27.9	27.8	27.8	27.7	27.6	27.5	27.88
28.0	28.2	28.2	28.4	28.1	28.4	28.5	28.3	28.4	27.9	28.0	27.7	27.7	27.86
27.9	27.9	28.0	28.0	27.9	28.8	28.1	28.0	28.1	28.0	28.1	28.0	28.0	27.91
28.1	28.2	28.3	28.4	28.7	28.5	28.5	28.3	28.1	28.1	28.1	28.0	28.1	28.12
27.9	28.0	28.0	28.1	28.0	28.0	28.0	28.0	27.8	27.8	27.7	27.6	27.6	27.91
27.5	27.7	27.8	27.9	27.9	27.9	27.8	27.6	27.6	27.6	27.6	27.5	27.6	27.60
28.1	28.1	28.1	28.2	28.2	28.1	28.1	28.0	27.9	27.8	27.8	27.8	27.8	27.83
27.6	27.6	27.6	27.7	27.7	27.8	27.8	27.8	27.7	27.7	27.7	27.7	27.6	27.67
28.0	28.0	28.0	28.1	28.1	28.0	28.1	28.0	27.9	28.0	28.0	28.0	27.7	27.84
28.0	28.1	28.1	28.1	28.2	28.2	28.1	28.1	28.0	28.0	28.0	27.8	27.7	27.94
28.3	28.3	28.3	28.3	28.5	28.3	28.2	28.1	28.2	28.2	28.3	28.2	28.2	28.13
28.6	29.2	28.6	28.6	28.5	28.4	28.3	28.6	28.6	28.6	28.2	28.3	28.4	28.38
28.6	28.8	28.9	28.8	28.8	28.7	28.6	28.6	28.5	28.3	28.3	28.2	28.3	28.51
28.5	28.4	28.5	28.6	28.5	28.4	28.3	28.4	28.3	28.4	28.5	28.6	28.6	28.44
28.2	28.2	28.3	28.6	28.7	28.6	28.1	28.0	28.0	28.1	27.9	28.3	28.4	28.30
28.5	28.6	28.7	28.7	28.6	28.6	28.5	28.5	28.3	28.2	28.3	28.4	28.4	28.49
28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.6	28.5	28.4	28.3	28.3	27.9	28.54
28.6	28.7	28.7	28.6	28.4	28.6	28.6	28.6	28.4	28.3	28.3	28.2	28.1	28.44
28.5	28.5	28.6	28.6	28.5	28.4	28.2	28.3	28.2	28.2	28.4	28.3	28.4	28.33
28.5	28.5	28.6	28.7	28.7	28.7	28.6	28.7	28.7	28.8	28.7	28.3	28.6	28.58
27.4	27.4	27.3	27.2	27.3	27.3	27.3	27.3	27.4	27.3	27.3	27.3	27.2	27.48
27.2	27.2	27.1	27.0	26.8	26.7	26.7	26.6	26.6	26.7	26.6	26.8	26.8	26.97
26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.75
27.2	27.1	27.1	27.0	26.7	27.1	26.8	26.9	26.6	26.6	26.6	26.6	26.6	26.79
26.5	26.5	26.5	26.5	26.4	26.6	26.4	26.3	26.5	26.5	26.3	26.3	26.4	26.51
27.0	27.0	27.1	27.0	27.1	27.0	27.0	26.9	26.9	27.0	26.9	26.9	26.8	26.77
27.2	27.2	27.0	27.1	27.2	27.0	26.9	27.1	27.0	26.9	26.9	26.9	27.0	27.03
27.1	27.0	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.8	26.7	26.6	26.6	26.92
26.5	26.6	26.6	26.7	26.6	26.4	26.4	26.3	26.2	26.2	26.2	26.2	26.2	26.45
26.2	26.1	26.1	26.1	26.2	26.1	26.1	25.9	25.9	26.0	26.1	26.1	26.1	26.14
26.0	25.8	25.8	25.7	25.8	25.8	25.8	25.8	25.4	25.4	25.3	25.7	25.7	25.87
25.1	25.4	25.4	25.3	25.3	25.3	25.2	25.2	25.2	25.1	24.9	24.9	24.8	25.20
23.2	23.1	23.0	23.1	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.2	23.59
22.3	22.3	21.9	21.1	20.9	20.7	20.2	20.2	19.6	19.6	19.5	19.4	19.4	21.58
19.7	19.8	20.1	19.8	19.9	20.0	19.9	19.8	19.8	19.8	19.6	19.4	19.3	19.52
20.6	20.7	21.2	21.2	21.4	21.6	21.7	21.8	21.8	21.7	21.7	21.8	21.7	20.77
20.9	20.9	21.1	21.2	21.3	21.3	21.0	20.9	20.8	20.6	20.3	19.1	19.4	20.98
19.4	19.6	19.8	19.8	19.2	19.1	18.8	18.2	18.1	17.3	17.4	17.6	17.7	18.92
18.8	19.4	19.4	19.5	19.3	19.4	19.3	19.2	19.2	19.1	19.2	19.2	19.1	18.75
19.0	19.2	19.3	19.4	19.4	19.4	19.3	19.3	19.3	19.3	19.4	19.6	19.3	19.10
19.8	19.9	20.1	20.2	20.2	20.2	20.2	20.1	20.1	20.2	20.2	20.2	20.3	19.83
20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.8	20.7	20.7	20.7	20.7	20.7	20.61
20.8	20.9	21.0	21.1	21.1	21.1	21.2	21.2	21.3	21.3	21.3	21.3	21.3	20.95
21.5	21.7	21.9	22.3	22.4	22.5	22.4	22.4	22.4	22.4	22.4	22.4	22.4	21.78
22.7	22.8	22.8	22.7	22.6	22.6	22.6	22.6	22.2	22.2	22.2	22.1	22.1	22.48
22.3	22.4	22.4	22.5	22.6	22.6	22.7	22.7	23.0	23.1	23.4	23.3	23.4	22.54
23.3	23.4	23.4	23.5	23.7	23.7	23.7	23.7	23.8	23.7	23.7	23.7	23.7	23.50
23.9	23.9	24.0	23.8	23.8	23.7	23.7	23.7	23.7	23.7	23.6	23.6	23.7	23.76
24.0	24.0	24.1	24.2	24.2	24.2	24.2	24.2	24.2	23.9	23.7	23.7	23.7	23.93
24.2	24.2	24.2	24.2	24.2	23.8	23.8	24.0	24.0	23.8	23.8	23.8	23.8	23.98
23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.6	23.70
23.6	23.6	23.4	23.4	23.2	23.3	23.4	23.3	23.2	23.1	23.1	23.1	23.1	23.41
23.5	23.7	23.7	23.7	23.7	23.6	23.6	23.5	23.3	23.2	23.1	23.1	23.2	23.39
23.3	23.5	23.6	23.7	23.7	23.6	23.3	23.3	23.3	23.3	23.2	23.2	23.2	23.30
23.2	23.3	23.3	23.3	23.3	23.2	23.1	23.1	23.1	22.7	23.0	23.1	23.0	23.20
23.2	23.3	23.1	23.0	23.0	23.1	23.1	23.0	23.0	23.0	23.1	23.1	23.1	22.97
23.0	23.1	23.0	23.1	23.2	23.2	23.2	23.2	23.2	23.0	22.7	22.8	22.8	22.94
23.1	23.2	23.3	22.9	23.2	22.9	22.9	23.0	22.8	22.8	23.0	22.8	22.7	22.82
24.3	24.2	24.3	24.2	24.3	24.2	24.1	24.2	24.2	24.0	24.0	24.0	23.9	23.92
23.6	23.7	23.7	23.8	23.8	23.8	23.7	23.2	23.1	23.1	22.7	22.2	21.7	23.48
21.1	21.1	21.1	21.0	20.8	20.7	20.8	20.8	20.8	20.8	20.6	20.6	20.2	21.05

fluctuations during midday hours; overcast, gentle to light breeze. [d] Carnegie at Easter Island December 6-12.

Date	Latitude	Longitude east	Values in °C,										
			00	01	02	03	04	05	06	07	08	09	10
1928	°	°											
Dec. 16	32.0 S	249.1	20.1	20.0	19.8	19.9	20.1	20.2	20.1	20.1	20.2	20.2	20.3
17	31.8 S	250.6	20.6	20.5	20.5	20.6	20.6	20.6	20.8	20.8	20.8	20.9	21.1
18	31.9 S	251.0	20.9	20.7	20.7	20.7	20.7	20.7	20.7	21.0	21.0	21.0	21.1
19	32.5 S	252.6	19.4	19.4	19.5	19.6	19.6	19.7	19.7	19.8	19.9	20.2	20.5
20	34.0 S	253.4	19.4	19.5	19.7	19.6	19.7	19.7	19.7	19.6	19.2	19.1	19.2
21	35.3 S	254.6	19.2	18.8	18.7	18.8	18.7	18.9	19.0	19.1	19.2	19.4	19.3
22	36.9 S	255.9	18.4	18.0	17.3	17.1	17.0	16.8	17.0	17.0	16.7	16.7	16.9
23	38.7 S	257.1	16.3	16.4	16.3	16.3	16.3	16.2	16.1	16.2	16.2	16.1	15.8
24	39.9 S	259.0	15.3	15.5	15.7	15.8	15.8	15.8	15.8	16.1	16.3	16.4	16.4
26	40.4 S	262.5	14.8	14.6	14.7	14.6	14.7	14.7	14.7	14.7	14.8	15.0	15.4
27	39.9 S	263.7	15.5	15.3	15.4	15.3	15.4	15.4	15.4	15.5	15.7	16.0	15.8
28	38.4 S	265.8	16.7	16.7	16.7	16.8	16.8	16.6	16.6	16.7	16.8	17.1	17.1
29	36.6 S	267.0	17.7	17.8	17.8	17.8	17.8	17.8	17.9	18.3	18.4	18.7	18.7
30	34.5 S	268.2	18.6	18.6	18.4	18.3	18.7	19.1	19.1	19.2	19.2	19.4	19.4
31	32.5 S	270.0	19.4	19.4	19.3	19.3	19.4	19.6	19.4	19.7	19.9	20.2	20.4
1929													
Jan. 1[a]	32.2 S	270.9	20.3	20.2	20.3	20.1	20.3	20.4	20.5	20.3	20.3	20.7	20.8
2	31.9 S	271.1	20.9	21.1	20.8	20.7	20.6	20.8	20.6	20.6	20.8	20.7	21.1
3	31.9 S	271.7	20.8	20.7	20.8	20.7	20.6	20.6	20.6	20.6	20.6	20.8	20.9
4	31.8 S	272.7	20.6	20.7	20.8	20.4	20.5	20.5	20.5	20.5	20.8	20.7	20.6
5	31.0 S	273.4	20.3	20.2	20.1	20.3	20.2	20.2	20.2	20.3	20.2	20.2	20.3
6	28.9 S	274.7	19.9	19.7	19.8	19.8	20.0	19.8	19.7	19.8	19.9	19.8	20.0
7	27.0 S	276.0	19.6	19.7	19.7	19.6	19.3	19.6	19.5	19.5	19.3	19.4	19.4
8	25.0 S	277.8	19.1	19.0	19.0	19.0	19.0	19.0	19.1	19.2	19.2	19.2	19.2
9	23.1 S	278.8	19.2	19.2	19.1	19.1	19.0	19.0	19.1	19.2	19.2	19.1	19.1
10	21.4 S	279.5	18.8	18.9	18.8	19.2	19.1	19.2	19.2	19.2	19.2	19.2	19.1
11	19.1 S	280.7	18.9	18.8	18.8	18.8	18.8	18.8	19.0	19.1	19.2	19.2	19.5
12	16.7 S	281.4	19.7	19.9	20.2	20.3	20.7	21.1	21.3	21.3	21.2	21.4	21.5
13	14.1 S	282.1	22.1	22.0	21.9	21.9	22.1	22.1	21.6	21.4	21.1	20.8	21.0
14[b]	12.3 S	282.8	21.5	20.6	20.1	19.7	19.5	19.3	19.5	19.4	19.4	19.2	18.8
Feb. 6[c]	11.9 S	281.4	21.1	21.4	21.7	22.4	23.0	23.3	23.3	23.3	23.3	23.3	23.3
7	10.2 S	280.1	23.2	23.3	23.5	23.7	23.7	23.5	23.3	22.9	23.1	23.1	23.0
8	10.0 S	277.8	23.9	24.0	24.0	24.0	24.2	24.9	24.9	25.0	24.9	24.9	24.9
9	10.4 S	275.8	24.8	24.8	24.8	24.8	24.8	24.9	24.8	24.8	24.7	24.7	24.8
10	10.8 S	275.0	25.1	25.0	24.9	24.9	24.9	24.9	24.9	25.0	25.1	25.2	25.5
11[d]	10.7 S	274.1	25.5	25.4	25.4	25.3	25.3	25.2	25.2	25.2	25.1	25.2	25.2
12	11.0 S	272.6	24.7	24.7	24.7	24.6	24.6	24.5	24.5	24.6	24.4	24.3	24.3
13	12.6 S	270.3	24.2	24.2	24.1	24.1	24.1	24.0	23.9	23.9	23.9	23.9	23.8
14	14.4 S	267.8	23.1	23.0	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
15	15.8 S	265.1	22.8	22.9	22.9	22.9	22.8	22.7	22.7	22.8	22.8	22.8	22.8
16	15.3 S	262.4	22.9	23.0	23.2	23.3	23.3	23.3	23.3	23.2	23.2	23.3	23.3
17	14.8 S	259.2	23.2	23.2	23.2	23.2	23.2	23.4	23.5	23.5	23.5	23.5	23.5
22	12.6 S	247.7	25.0	25.1	25.2	25.1	25.0	25.0	25.2	25.2	25.2	25.2	25.2
23	12.5 S	244.9	25.3	25.3	25.4	25.5	25.5	25.4	25.6	25.6	25.6	25.6	25.6
24	12.7 S	242.4	25.7	25.7	25.7	25.7	25.7	25.8	26.0	26.0	26.0	26.0	26.0
25	12.8 S	240.6	26.1	26.1	26.1	26.2	26.2	26.3	26.3	26.3	26.3	26.3	26.4
26	13.0 S	238.7	26.3	26.3	26.4	26.4	26.4	26.4	26 3	26.4	26.4	26.4	26.4
27	13.5 S	235.9	26.6	26.6	26.7	26.7	26.7	26.7	26.8	26.7	26.7	26.7	26.7
28	14.9 S	233.8	26.7	26.8	26.9	26.9	27.0	27.1	27.1	27.1	27.1	27.1	27.1
Mar. 1	16.5 S	231.9	27.3	27.3	27.3	27.3	27.4	27.5	27.5	27.4	27.4	27.4	27.4
2	17.0 S	230.2	27.4	27.5	27.4	27.4	27.4	27.4	27.3	27.3	27.3	27.4	27.5
3	17.1 S	228.3	27.5	27.5	27.5	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6
5	17.1 S	224.6	27.5	27.5	27.5	27.5	27.6	27.5	27.5	27.5	27.5	27.6	27.6
6[e]	17.2 S	223.4	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.9	28.0
7[f]	17.4 S	221.1	28.4	28.6	27.9	28.6	28.1	27.8	28.1	27.8	27.9	28.1	28.4
8	17.8 S	219.2	28.2	28.1	28.2	28.2	28.2	28.2	28.1	28.1	28.3	28.1	28.6
9	17.6 S	218.0	28.2	28.1	28.1	28.2	28.2	28.0	28.1	28.1	28.2	28.2	28.3
10	18.0 S	215.9	28.1	28.1	28.2	28.3	28.2	28.2	28.2	28.1	28.1	28.1	28.1
11	18.1 S	214.4	28.0	28.1	28.2	28.2	28.2	28.1	27.8	27.9	27.8	27.8	27.8
12	17.9 S	212.0	28.0	28.0	28.0	28.2	28.3	28.2	28.1	28.1	28.0	28.1	28.3
21[c]	16.8 S	209.2	28.2	28.3	28.3	28.3	28.2	28.2	28.2	28.2	28.2	28.2	28.3
22	17.6 S	208.2	28.3	28.3	28.3	28.4	28.4	28.4	28.4	28.3	28.3	28.2	28.1
23	17.2 S	207.3	28.1	28.1	28.1	28.3	28.3	28.3	28.3	28.2	28.3	28.4	28.5
24	16.9 S	206.3	28.7	28.4	28.6	28.8	28.7	28.7	28.6	28.6	28.6	28.6	28.7
25	16.5 S	204.0	28.6	28.7	28.6	28.6	28.6	28.5	28.4	28.4	28.4	28.3	28.3
27	15.7 S	199.4	28.7	28.7	28.7	28.6	28.7	28.6	28.6	28.6	28.5	28.5	28.5
28	15.5 S	198.0	28.6	28.5	28.5	28.6	28.5	28.5	28.5	28.5	28.5	28.6	28.6
29	15.3 S	196.7	28.6	28.6	28.6	28.6	28.5	28.4	28.3	28.1	28.2	28.3	28.3
30	14.7 S	194.4	28.7	29.0	28.6	28.5	28.5	28.6	28.7	28.7	28.7	28.9	29.0

[a] Very rapid fluctuations of as much as 2°5 within 15m, between 10h and 24h; western edge of Humboldt Current. [b] Irregular fluctuations between 09h and 19h; fall in temperature of about 5°5. [c] *Carnegie* at Callao January 14-February 5; at Papeete March 13-20. [d] Calm, clear day with characteristic

temperature, Carnegie, 1928-29--Continued

local mean hour													Mean
11	12	13	14	15	16	17	18	19	20	21	22	23	
													°C
20.4	20.4	20.3	20.3	20.2	20.0	20.2	20.5	20.6	20.6	20.6	20.6	20.6	20.26
21.0	21.2	20.9	21.1	21.2	21.3	21.2	21.2	21.2	21.1	21.1	21.0	21.0	20.93
21.1	21.1	20.8	20.6	20.7	19.9	19.7	19.7	19.7	19.6	19.6	19.5	19.5	20.45
20.7	20.5	20.2	20.3	20.2	20.0	19.8	19.7	19.3	19.2	19.3	19.5	19.4	19.81
19.3	19.3	19.7	19.8	19.7	19.7	19.5	19.5	19.6	19.5	19.4	19.4	19.3	19.50
19.3	19.4	19.6	19.7	19.8	19.9	19.3	19.0	18.7	18.3	18.4	18.3	18.1	19.04
17.0	17.2	17.3	17.3	17.2	17.1	16.9	16.9	16.8	16.8	16.7	16.6	16.4	17.05
15.7	15.4	15.4	15.5	15.6	15.7	15.5	15.3	15.4	15.4	15.5	15.4	15.3	15.80
16.4	16.3	16.3	16.4	15.0	14.5	14.6	14.6	14.3	14.4	14.3	14.4	14.4	15.45
15.5	15.8	15.9	16.2	16.3	15.9	15.7	16.0	15.9	16.0	15.8	15.6	15.8	15.38
16.2	16.4	16.5	16.4	16.3	16.2	16.3	16.3	16.3	16.6	16.6	16.7	16.7	16.01
17.2	17.3	17.0	17.8	17.6	17.6	17.5	17.5	17.8	17.8	17.8	17.7	17.7	17.20
18.8	18.8	18.9	19.3	19.3	19.6	19.5	19.6	18.9	18.8	18.8	18.8	18.7	18.60
19.5	19.4	19.4	19.7	19.8	20.1	20.0	19.8	19.8	20.0	19.7	19.7	19.4	19.35
20.3	20.7	20.8	20.6	20.9	21.0	21.2	20.8	20.3	20.4	20.3	20.2	20.3	20.16
21.3	21.9	20.5	20.6	22.9	22.8	20.6	22.0	20.6	22.0	20.8	20.5	20.8	20.90
21.3	21.2	21.1	21.2	21.3	20.6	20.5	20.8	20.7	20.3	20.5	20.7	20.7	20.82
21.2	21.3	21.6	21.7	21.6	21.8	21.0	21.1	20.7	20.7	20.7	20.9	20.8	20.95
20.7	20.8	21.2	21.4	21.0	21.2	21.2	21.2	21.0	20.9	20.7	20.5	20.2	20.78
20.5	20.4	20.4	20.2	20.3	20.6	20.5	20.3	20.0	20.5	20.1	20.1	20.1	20.27
19.7	19.8	19.7	19.9	19.8	19.8	19.7	19.7	19.7	19.7	19.7	19.6	19.6	19.78
19.4	19.3	19.6	19.5	19.3	19.3	19.5	19.3	19.3	19.4	19.3	19.2	19.1	19.42
19.2	19.1	19.2	19.2	19.2	19.2	19.4	19.4	19.4	19.3	19.2	19.3	19.2	19.18
19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.1	19.1	18.9	18.8	19.13
19.1	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.0	19.0	19.1	19.12
19.8	19.9	19.9	20.0	19.9	19.8	19.8	19.8	19.7	19.7	19.8	19.6	19.5	19.42
21.5	21.4	21.3	21.3	21.2	21.1	20.9	20.9	20.9	21.0	21.0	21.4	21.8	21.01
21.2	21.0	21.1	21.4	21.4	21.5	21.5	21.5	21.6	21.7	21.9	21.7	21.5	21.54
18.7	19.2	18.9	18.0	16.7	14.8	13.9	14.1	14.0	13.9	13.9	13.9	13.8	17.53
23.5	23.5	23.4	22.9	22.9	23.0	23.1	23.1	23.1	23.1	23.0	23.0	23.0	22.92
23.2	23.5	23.7	23.7	23.7	23.4	23.6	23.7	24.1	24.2	24.2	24.2	23.9	23.56
25.0	25.0	25.1	25.1	25.2	25.1	25.1	25.0	25.0	24.9	24.8	24.8	24.8	24.77
24.9	25.1	25.2	25.4	25.6	25.7	25.7	25.5	25.3	25.2	25.2	25.1	25.2	25.08
25.7	25.8	25.9	25.7	25.6	26.4	27.4	26.7	26.0	25.7	25.6	25.6	25.4	25.54
25.4	25.6	25.6	25.6	25.6	25.6	25.4	25.3	25.1	25.0	24.0	24.8	24.8	25.28
24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.2	24.2	24.1	24.2	24.2	24.2	24.38
23.8	23.9	24.0	23.9	23.9	23.8	23.7	23.6	23.6	23.6	23.5	23.4	23.2	23.83
22.8	22.8	22.9	22.9	22.9	22.8	22.9	22.8	22.8	22.8	22.7	22.7	22.7	22.83
22.8	22.9	22.9	22.9	23.0	23.1	23.1	23.1	23.1	23.0	23.0	23.0	23.0	22.91
23.3	23.2	23.2	23.2	23.2	23.2	23.3	23.3	23.3	23.4	23.4	23.3	23.2	23.24
23.4	23.5	23.5	23.6	23.6	23.7	23.7	23.7	23.6	23.6	23.6	23.6	23.7	23.49
25.2	25.2	25.4	25.4	25.5	25.5	25.3	25.5	25.6	25.4	25.4	25.4	25.4	25.28
25.6	25.6	25.7	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.7	25.7	25.56
26.0	26.0	26.0	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.0	26.1	26.2	25.97
26.5	26.6	26.6	26.6	26.6	26.6	26.6	26.6	26.5	26.5	26.5	26.4	26.4	26.40
26.4	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.6	26.7	26.7	26.46
26.7	26.7	26.7	26.7	26.7	26.8	26.8	26.8	26.8	26.7	26.7	26.7	26.7	26.71
27.1	27.1	27.2	27.3	27.3	27.3	27.3	27.4	27.3	27.3	27.3	27.2	27.2	27.13
27.4	27.5	27.5	27.5	27.6	27.6	27.5	27.5	27.5	27.5	27.5	27.5	27.5	27.45
27.5	27.5	27.5	27.6	27.6	27.6	27.6	27.5	27.6	27.5	27.5	27.5	27.5	27.47
27.6	27.7	27.7	27.8	27.9	27.7	27.7	27.7	27.6	27.6	27.5	27.6	27.5	27.62
27.6	27.7	27.7	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.8	27.66
28.2	28.2	28.8	28.7	29.6	29.7	29.8	29.1	29.1	28.3	28.3	28.9	28.5	28.39
28.3	28.9	29.6	29.6	29.5	29.6	29.5	29.0	28.7	28.6	28.6	28.2	28.2	28.58
28.7	28.7	29.0	29.1	28.9	28.9	28.6	28.6	28.5	28.4	28.4	28.4	28.3	28.45
28.4	28.4	28.5	28.4	28.4	28.5	28.3	28.3	28.2	28.2	28.1	28.2	28.2	28.24
28.2	28.2	28.2	28.2	28.3	28.2	28.2	28.2	27.7	27.8	28.2	28.1	27.9	28.13
27.8	27.9	27.8	27.7	27.7	27.7	27.7	27.7	27.7	27.8	27.7	27.8	27.9	27.87
28.2	28.3	28.2	28.1	28.2	28.4	28.4	28.5	28.5	28.4	28.4	28.3	28.5	28.24
28.3	28.3	28.4	28.2	28.2	28.2	28.2	28.2	28.3	28.3	28.3	28.3	28.3	28.25
28.0	28.0	28.0	28.1	28.1	28.1	28.1	28.1	28.0	28.0	28.0	28.1	28.1	28.17
28.7	28.6	29.2	29.3	29.5	29.4	29.2	28.8	28.7	28.8	28.7	28.7	28.9	28.64
29.1	28.7	28.7	28.7	28.7	28.8	28.7	28.6	28.5	28.6	28.7	28.5	28.6	28.66
28.4	28.5	28.5	28.6	28.6	28.5	28.6	28.5	28.6	28.6	28.6	28.6	28.4	28.52
28.5	28.6	28.6	28.6	28.7	28.7	28.7	28.6	28.6	28.6	28.6	28.6	28.6	28.61
28.6	28.7	28.8	29.0	28.9	28.8	28.8	28.7	28.8	28.7	28.7	28.6	28.6	28.65
28.3	29.5	29.6	30.0	29.9	29.7	29.5	29.4	28.7	28.7	28.7	28.6	28.6	28.82
29.1	29.5	29.6	29.6	29.6	29.5	29.5	29.3	29.5	29.1	29.1	29.1	29.1	29.06

small, rapid changes in temperature during late afternoon. [e] Small, rapid fluctuations in temperature during late afternoon; clear, calm. [f] Small, rapid fluctuations in temperature during late afternoon; clear, calm.

Table 1. Hourly values of sea-surface

Date	Latitude	Longitude east	Values in °C,										
			00	01	02	03	04	05	06	07	08	09	10
1929	°	°											
Mar. 31	14.7 S	192.1	29.0	29.1	29.1	29.0	28.9	28.8	28.7	28.6	28.6	28.6	28.6
Apr. 22[a]	12.7 S	188.4	29.4	29.4	29.4	29.4	29.3	29.3	29.2	29.2	29.2	29.2	29.2
23	11.3 S	188.4	29.1	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.2	29.2
24	8.7 S	189.0	29.1	29.4	29.3	29.3	29.3	29.3	29.2	29.2	29.2	29.2	29.2
25[b]	7.6 S	188.2	29.2	29.2	29.2	29.1	29.1	29.1	29.1	29.1	29.1	29.0	29.0
26[c]	6.7 S	187.6	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.0	29.0	29.1	29.1
27[d]	5.1 S	187.6	28.9	29.1	28.8	28.7	28.7	28.6	28.4	28.4	28.4	28.4	28.6
28	3.8 S	187.4	28.1	28.3	28.2	28.2	28.1	28.1	28.1	28.1	28.0	28.1	28.1
29	1.8 S	186.6	28.1	28.0	27.8	27.8	27.7	27.7	27.7	27.6	27.6	27.6	27.6
30	0.4 N	185.9	27.2	27.2	27.2	27.2	27.1	27.0	26.9	26.9	26.8	26.8	26.8
May 1	2.5 N	184.9	27.2	27.2	27.2	27.2	27.1	27.1	27.2	27.4	27.5	27.5	27.6
2	4.4 N	183.6	27.9	27.8	27.8	27.7	27.7	27.7	27.7	27.7	27.6	27.6	27.6
3	6.5 N	182.3	27.6	27.7	27.7	27.7	27.7	27.6	27.7	27.7	27.6	27.7	27.7
4	8.2 N	181.1	27.6	27.5	27.5	27.5	27.5	27.5	27.5	27.4	27.4	27.4	27.4
5	10.8 N	180.5	27.2	27.2	27.2	27.2	27.2	27.0	27.0	26.9	26.9	26.8	26.8
	Crossed International Date Line												
7	13.5 N	177.4	26.2	26.5	26.4	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2
8	15.4 N	174.7	26.0	25.9	25.9	25.9	26.1	26.1	26.0	26.0	26.0	25.9	25.9
9	16.5 N	171.9	26.1	26.2	26.1	25.9	25.7	25.7	25.6	25.7	25.7	25.7	25.7
10	18.5 N	169.0	26.0	26.0	26.0	25.9	25.8	25.7	25.7	25.7	25.7	25.7	25.7
12	20.3 N	163.7	25.6	25.5	25.5	25.6	25.7	25.7	25.7	25.7	25.7	25.7	25.7
13	20.2 N	161.2	25.8	25.8	25.9	25.9	25.7	25.7	25.7	25.7	25.7	25.7	25.9
14	19.5 N	158.5	26.7	26.6	26.4	26.3	26.3	26.2	26.2	26.1	26.1	26.1	26.2
15	18.7 N	156.1	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
16	17.5 N	153.4	27.3	27.3	27.2	27.2	27.1	27.1	27.2	27.3	27.2	27.1	26.9
17	16.1 N	150.9	27.3	27.3	27.3	27.3	27.3	27.3	27.2	27.1	27.1	27.1	27.1
18	14.9 N	148.3	27.6	27.6	27.6	27.6	27.6	27.6	27.5	27.5	27.5	27.5	27.5
19	14.0 N	146.0	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7
26[a]	16.1 N	144.2	28.2	28.2	28.2	28.1	28.1	28.2	28.2	28.1	28.1	28.2	28.2
27	18.6 N	144.0	28.3	28.1	28.1	28.2	28.1	28.1	28.1	28.1	28.1	28.1	28.1
28	21.5 N	144.2	28.7	28.7	28.7	28.7	28.6	28.6	28.7	28.6	28.2	28.3	28.3
29	23.4 N	144.2	28.6	28.7	28.6	28.5	28.5	27.4	27.6	27.2	27.3	27.3	27.3
30[e]	25.3 N	144.1	25.8	26.3	26.3	25.9	26.0	26.3	26.2	26.6	26.5	26.7	26.6
31	26.4 N	144.4	25.9	25.3	24.0	23.7	23.9	23.7	24.4	23.9	24.1	23.9	23.9
June 1	28.5 N	144.0	23.5	24.1	24.2	24.2	24.1	23.9	24.2	24.0	24.0	24.1	24.0
2	30.2 N	143.9	20.7	20.5	20.5	20.5	20.5	20.4	20.5	20.5	20.4	20.1	20.3
3	31.1 N	144.3	20.5	20.4	20.3	20.3	20.4	20.5	20.3	20.1	20.1	20.1	20.1
4	32.7 N	142.3	20.1	20.3	20.3	20.3	20.2	20.0	20.1	20.1	20.2	20.1	20.0
5	34.0 N	141.2	21.9	22.3	22.4	22.5	22.7	23.0	23.2	23.3	23.3	23.3	23.3
6	34.9 N	140.2	19.9	19.1	18.5	18.5	18.5	18.8	18.8	19.0	18.8	18.5	18.9
7[f]	34.9 N	139.9	18.3	18.3	18.2	18.0	18.2	18.2	18.0	18.5	18.5	17.7	15.6
25[g]	34.7 N	141.0	24.5	24.5	24.2	24.4	24.3	24.1	24.1	24.0	24.1	24.2	24.3
26	36.0 N	142.1	23.4	20.0	20.0	20.1	20.2	20.1	19.4	19.5	19.5	19.5	19.5
27	36.7 N	143.6	19.1	18.9	18.8	18.5	18.8	19.2	19.6	19.8	19.7	19.8	20.2
28	36.8 N	145.4	20.5	20.0	20.0	20.4	19.9	19.8	20.0	19.8	20.0	19.8	19.8
29	37.8 N	145.5	20.0	19.5	19.5	19.9	20.1	20.3	20.4	20.4	20.5	20.5	20.5
30[h]	38.1 N	147.1	20.7	21.0	20.7	19.0	19.0	19.0	19.0	18.9	18.8	17.7	15.5
July 1	38.7 N	147.7	15.0	14.9	14.6	14.7	14.8	14.9	15.4	15.5	15.7	16.0	16.0
2	39.8 N	149.5	16.0	15.7	15.5	15.4	15.5	15.5	15.4	15.2	15.2	15.1	13.1
3	40.4 N	151.1	15.0	14.6	14.5	14.7	14.9	15.0	15.5	15.5	15.8	15.9	15.9
4	41.3 N	153.1	15.3	14.5	14.1	13.1	13.8	14.0	13.9	13.5	12.5	12.5	13.2
5	42.6 N	155.6	10.4	10.2	10.4	10.3	10.4	10.3	10.2	10.3	10.3	10.3	10.3
6	43.8 N	158.3	10.1	9.4	10.2	9.5	9.4	9.4	9.5	9.5	9.3	9.6	9.6
7	45.4 N	159.6	7.9	7.9	7.7	7.8	7.6	7.5	7.3	7.1	7.0	6.9	6.9
8[i]	46.9 N	163.0	7.2	7.1	7.1	7.0	7.0	7.1	7.1	7.2	7.5	7.9	6.8
9	47.0 N	166.6	7.4	7.3	7.2	7.2	7.3	7.3	7.3	7.4	7.1	7.2	7.2
10	46.7 N	169.5	7.6	7.5	7.4	7.4	7.4	7.4	7.3	7.3	7.3	7.3	7.4
11	46.0 N	171.7	7.8	7.9	7.9	7.9	7.9	7.9	7.8	7.6	7.5	7.4	7.5
12	45.3 N	173.1	8.9	8.6	8.7	8.6	8.7	8.7	8.6	8.6	8.6	8.6	8.6
13	46.2 N	174.1	8.7	8.9	8.9	8.9	8.8	8.5	8.5	8.4	8.4	8.3	8.2
14[a]	48.1 N	178.1	8.3	8.4	8.4	8.4	8.2	8.2	8.2	8.2	8.2	8.1	8.2
14[b]	49.2 N	183.3	8.3	8.3	8.4	8.4	8.4	8.2	8.2	8.1	8.0	8.1	8.1
15	50.5 N	187.2	8.2	8.3	8.3	8.4	8.2	8.2	8.1	8.2	8.2	8.2	8.1
16	51.4 N	192.7	8.2	8.2	8.4	8.4	8.4	8.4	8.5	8.6	8.5	8.8	8.8

[a] Carnegie at Pago Pago April 1-5; at Apia April 6-20; at Guam May 20-25. [b] Characteristic small, rapid fluctuations during afternoon; partly cloudy, calm during midday. [c] Characteristic small, rapid fluctuations during afternoon; partly cloudy, calm during midday. [d] Characteristic small, rapid fluctuations during afternoon; partly cloudy, calm during midday. [e] Small irregular fluctuations in temperature during entire day; partly cloudy, calm to gentle breeze. [f] Carnegie at Yokohama June 7-24. [g] Very irreg-

temperature, Carnegie, 1928-29--Continued

local mean hour													Mean
11	12	13	14	15	16	17	18	19	20	21	22	23	
													°C
28.7	28.9	29.0	29.1	29.1	29.1	28.9	28.9	28.9	28.8	28.7	28.6	28.8	28.85
29.1	29.1	29.2	29.2	29.3	29.0	29.0	29.1	29.1	29.1	29.1	29.1	29.1	29.20
29.3	29.3	29.3	29.3	29.2	29.2	29.2	29.2	29.2	29.1	29.2	29.1	29.1	29.23
29.2	29.2	29.3	29.4	29.2	29.2	29.3	29.3	29.3	29.2	29.2	29.2	29.2	29.25
29.0	29.1	29.3	29.4	29.4	29.2	29.5	29.5	29.5	29.3	29.2	29.1	29.1	29.20
29.9	29.9	29.4	29.6	29.0	29.1	29.5	29.7	29.5	29.0	29.3	29.3	29.0	29.25
29.0	29.1	29.1	29.2	29.1	29.2	28.6	28.6	28.6	28.4	28.5	28.4	28.4	28.72
28.2	28.2	28.4	28.4	28.5	28.5	28.4	28.4	28.2	28.2	28.1	28.1	28.1	28.21
27.6	27.5	27.5	27.6	27.6	27.6	27.6	27.6	27.4	27.3	27.3	27.2	27.2	27.59
26.8	26.8	26.9	27.1	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.2	27.06
27.6	27.7	27.8	27.9	28.0	27.9	27.9	27.9	27.9	27.9	27.8	27.8	27.8	27.59
27.6	27.6	27.6	27.6	27.6	27.7	27.7	27.7	27.7	27.7	27.7	27.6	27.6	27.68
27.6	27.6	27.6	27.6	27.6	27.6	27.5	27.6	27.6	27.6	27.6	27.6	27.6	27.63
27.4	27.4	27.4	27.4	27.4	27.4	27.3	27.3	27.3	27.3	27.3	27.3	27.2	27.40
26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.7	26.2	26.2	26.2	26.2	26.77
26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.0	26.0	26.0	26.20
26.0	26.0	26.1	26.1	25.8	25.8	25.8	25.9	25.8	25.9	25.9	26.0	26.0	25.95
25.7	25.7	25.7	25.9	26.0	26.0	26.0	26.1	26.0	26.0	26.1	26.1	26.1	25.90
25.5	25.5	25.5	25.5	25.5	25.8	25.9	26.0	26.0	26.0	26.0	26.0	25.8	25.79
25.7	25.7	25.7	25.7	25.8	25.9	25.9	25.8	25.8	25.8	25.8	25.9	26.0	25.74
26.1	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.4	26.4	26.5	26.5	26.04
26.3	26.8	26.8	26.8	26.6	26.7	26.6	26.6	26.6	26.6	26.7	26.8	26.8	26.50
26.8	26.8	26.8	26.9	26.9	26.9	26.9	27.1	26.9	26.8	26.9	26.9	27.2	26.86
26.9	26.9	27.1	27.3	27.4	27.5	27.5	27.3	27.3	27.3	27.3	27.3	27.3	27.22
27.3	27.3	27.3	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.6	27.31
27.6	27.6	27.6	27.7	27.7	27.7	27.6	27.6	27.7	27.7	27.7	27.7	27.7	27.61
27.8	27.8	27.9	28.0	28.1	28.1	28.1	28.0	28.0	27.9	27.8	27.8	27.8	27.83
28.2	28.2	28.2	28.3	28.3	28.2	28.2	28.2	28.2	28.2	28.2	28.2	28.2	28.19
28.2	28.4	28.6	28.6	28.8	28.4	28.4	28.4	28.5	28.5	28.3	28.3	28.6	28.31
27.8	27.6	27.7	27.9	27.8	28.5	28.6	28.5	28.5	28.6	28.6	28.8	28.7	28.40
27.4	27.4	27.5	27.5	27.3	26.5	25.9	25.9	25.7	26.1	25.9	25.9	25.7	27.15
26.7	26.4	26.4	26.4	26.5	26.7	26.5	26.4	26.3	26.3	26.2	25.9	25.9	26.33
24.5	24.7	24.8	24.8	24.8	24.3	24.5	24.4	24.2	24.0	23.4	23.8	23.5	24.27
23.8	23.5	22.9	22.8	21.9	21.6	21.4	20.9	20.9	21.0	20.8	20.8	20.7	22.80
20.4	20.4	20.5	20.5	20.4	20.3	20.3	20.2	20.1	20.1	20.2	20.2	20.5	20.38
20.1	20.3	20.2	20.5	20.1	20.1	20.0	19.9	19.9	19.9	20.0	20.1	20.2	20.18
20.1	20.4	20.3	20.4	20.5	20.5	20.1	20.0	20.0	20.5	21.4	21.5	21.5	20.37
23.3	23.4	23.4	23.3	23.5	22.9	21.5	22.0	21.4	19.1	19.5	19.4	19.5	22.23
19.0	19.0	18.9	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.72
16.8	17.0	17.0	17.4	17.4	17.7	16.3	16.2	17.3	19.5	19.6	19.5	19.5	17.86
24.3	24.3	24.3	24.2	24.3	24.3	24.4	24.4	24.3	24.1	21.9	23.5	23.5	24.10
21.0	21.0	20.9	19.8	17.5	18.9	20.4	18.6	18.8	18.5	18.5	18.5	19.3	19.70
19.8	19.9	20.0	20.0	20.0	20.3	20.5	20.5	20.5	20.5	20.3	20.1	20.3	19.80
20.0	20.2	20.2	20.3	20.4	20.4	20.6	20.6	20.1	20.0	20.0	20.4	20.0	20.13
20.5	20.5	20.5	20.5	20.5	20.5	20.6	20.4	20.4	20.4	20.5	20.4	20.5	20.33
14.9	16.8	17.5	17.0	16.7	16.1	15.9	14.9	14.9	14.9	14.9	14.7	15.0	17.23
16.0	16.0	16.2	16.2	16.7	16.0	16.3	16.7	16.6	16.7	16.5	16.5	16.5	15.85
13.1	13.8	14.0	14.2	14.4	14.4	14.0	14.5	14.7	15.5	15.5	15.6	15.8	14.88
15.9	16.1	16.1	15.1	15.6	15.0	15.5	16.0	16.0	16.2	16.3	16.4	15.6	15.55
13.1	13.4	13.5	13.2	13.3	13.2	12.7	12.1	12.5	12.1	11.1	11.0	11.2	13.03
10.3	10.3	10.3	10.4	10.2	9.9	9.7	9.8	9.6	9.6	10.0	10.1	10.2	10.16
9.4	9.4	9.5	9.4	9.7	9.8	9.9	9.3	9.4	8.9	8.7	8.4	8.4	9.40
6.9	7.1	7.2	7.2	6.8	6.7	6.7	6.7	6.9	6.9	6.9	7.1	7.2	7.16
6.5	6.4	6.5	6.6	6.9	6.9	6.9	6.9	6.9	6.9	6.9	7.2	7.3	6.99
7.2	7.1	7.2	7.2	7.3	7.4	7.5	7.4	7.4	7.3	7.3	7.3	7.3	7.28
7.4	7.4	7.7	7.9	7.8	7.8	7.9	7.8	7.8	7.7	7.8	7.8	7.7	7.58
7.6	7.6	7.7	7.8	7.8	7.9	7.9	8.0	7.9	8.3	8.6	8.7	8.8	7.90
8.6	8.4	8.6	8.6	8.6	8.6	8.7	8.7	8.6	8.5	8.6	8.7	8.7	8.63
8.3	8.3	8.4	8.4	8.5	8.5	8.5	8.5	8.5	8.4	8.4	8.4	8.4	8.50
8.2	8.4	8.4	8.3	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.2	8.1	8.30
8.0	7.9	7.9	7.9	7.9	7.9	8.0	7.9	8.0	7.9	7.9	7.9	8.0	8.07
8.1	8.2	8.2	8.2	8.3	8.3	8.3	8.2	8.2	8.1	8.1	8.2	8.3	8.21
8.8	8.7	8.6	8.6	8.8	8.8	8.9	8.9	8.9	9.0	8.9	9.0	9.0	8.67

ular fluctuations beginning at 20h and continuing to 22h on 26th; in boundary zone between Japanese Current and cold on-shore currents. [h] Sudden fall in temperature of 5°8 between 08h and 09h 30m with small, rapid fluctuations until 15h; cloudy, light airs. [i] Lowest sea-surface temperature of cruise recorded at 12h; south of Aleutian Islands.

Table 1. Hourly values of sea-surface

Date	Latitude	Longitude east	Values in °C,										
			00	01	02	03	04	05	06	07	08	09	10
	°	°											
1929													
July 17	52.4 N	198.2	9.2	9.2	9.2	9.1	9.3	9.3	9.3	9.3	9.2	9.3	9.3
18	52.6 N	204.4	9.5	9.5	9.6	9.8	9.7	9.8	9.8	9.8	9.8	9.8	10.2
19	52.0 N	209.6	10.6	10.6	10.6	10.8	10.8	10.7	10.8	10.8	10.7	10.6	10.6
20	50.2 N	213.9	10.5	10.6	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
21	48.0 N	217.3	11.1	11.1	11.1	11.1	11.1	11.1	11.2	11.1	11.1	11.1	11.1
22	46.0 N	220.3	11.6	11.6	11.7	11.8	11.9	12.0	12.0	12.0	12.0	12.0	12.1
23	44.3 N	222.4	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.2	13.2	13.2	13.2
24	42.6 N	224.8	14.3	14.3	14.4	14.3	14.4	14.4	14.4	14.5	14.6	14.6	14.6
25	40.7 N	227.7	15.6	15.8	15.9	16.1	16.3	16.2	16.2	16.3	16.3	16.5	16.5
26	39.6 N	230.5	17.1	17.1	17.1	17.1	17.2	17.3	17.3	17.2	17.2	17.2	17.2
27	38.8 N	234.3	16.0	15.7	15.9	15.9	16.2	16.3	16.5	16.5	16.4	16.4	16.4
28[a]	38.2 N	237.2	11.8	12.0	12.2	12.2	12.2	12.6	12.0	10.4	10.2	10.0	11.6
Sep. 4[b]	37.0 N	236.3	13.9	14.4	15.6	16.6	16.6	16.8	16.5	16.3	16.3	16.3	16.3
5	35.5 N	235.0	17.2	17.4	17.5	17.1	17.4	17.5	18.1	18.2	18.4	18.4	18.1
6	33.8 N	233.7	19.1	18.1	18.6	19.0	18.6	18.8	18.9	19.4	19.1	19.1	19.1
7	32.4 N	232.1	20.1	20.0	20.0	19.9	20.0	19.9	19.9	19.9	19.8	19.7	19.7
8	31.6 N	231.2	20.9	20.9	20.5	20.6	20.6	20.8	20.7	20.9	20.9	20.9	20.9
9	30.4 N	229.0	21.5	21.6	21.4	21.5	21.8	21.8	21.6	21.8	21.8	21.5	21.5
10	29.3 N	227.4	22.2	22.2	22.3	22.3	22.3	22.3	22.3	22.6	22.5	22.5	22.5
11	28.2 N	225.7	22.3	22.4	22.3	22.3	22.7	22.5	22.6	22.7	22.6	22.6	22.5
12	27.7 N	224.6	22.8	22.8	22.8	22.8	22.9	22.9	22.9	22.9	22.8	22.8	22.9
13[c]	27.0 N	222.3	23.8	23.8	23.8	23.8	23.8	23.7	23.8	23.8	23.8	23.8	23.8
14	26.7 N	220.9	23.9	24.0	24.0	23.9	23.9	23.9	23.8	23.8	23.8	23.8	23.8
15	26.5 N	219.4	24.0	24.1	24.1	24.0	24.0	23.9	23.8	23.9	23.9	23.9	24.2
16	26.2 N	217.9	24.8	24.8	24.8	24.7	24.8	24.8	24.8	24.7	24.6	24.5	24.5
17	25.1 N	216.4	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2
18	24.0 N	214.4	25.4	25.4	25.3	25.3	25.3	25.5	25.5	25.4	25.3	25.3	25.3
19	23.4 N	211.3	25.6	25.6	25.5	25.6	25.6	25.6	25.6	25.6	25.8	25.9	26.2
Oct. 3[b]	23.5 N	200.4	26.3	26.4	26.3	26.4	26.4	26.4	26.4	26.6	26.7	26.7	26.7
4	26.4 N	199.5	26.3	26.3	26.2	26.2	26.3	26.3	26.2	26.4	26.4	26.4	26.6
5	29.1 N	198.8	25.6	25.7	25.7	25.7	25.7	25.6	25.7	25.8	25.8	25.8	25.7
6	31.7 N	199.0	25.2	25.1	24.6	24.6	24.8	24.6	24.3	24.3	24.3	24.3	24.3
7	32.8 N	199.3	24.2	24.3	24.3	24.3	24.1	24.0	24.1	24.1	24.1	24.0	24.1
11	33.7 N	208.3	22.6	22.8	22.8	22.9	22.8	22.8	23.2	23.3	23.3	23.2	23.2
12	33.3 N	212.3	22.7	22.6	22.5	22.8	22.7	22.7	22.7	22.7	22.7	22.3	22.3
13	33.4 N	214.6	22.0	22.1	22.0	22.1	22.3	22.1	22.1	22.3	22.3	22.3	22.3
14	33.6 N	216.9	22.2	22.3	22.3	22.4	22.4	22.3	22.2	21.9	22.1	22.0	21.9
15	31.8 N	219.3	22.4	22.4	22.5	22.5	22.4	22.3	22.3	22.3	22.3	22.3	22.2
16	29.1 N	220.8	21.9	22.5	22.1	22.6	22.8	22.8	22.8	22.8	22.8	22.8	22.8
17[b]	27.4 N	221.9	22.9	23.1	23.2	23.3	23.3	23.3	23.2	23.2	23.2	23.2	23.2
19	25.0 N	222.2	23.2	23.2	22.9	23.2	23.4	23.1	23.1	23.4	23.4	23.4	23.4
20	23.2 N	221.7	23.4	23.4	23.5	23.6	23.9	23.9	23.9	23.9	23.9	23.9	23.9
21	21.2 N	221.5	23.7	23.6	23.7	23.6	23.6	23.6	23.4	23.5	23.5	23.4	23.4
22	18.3 N	222.0	23.7	23.8	23.8	24.0	24.0	24.0	24.2	24.4	24.7	24.8	24.7
23	16.2 N	223.0	25.3	25.3	25.4	25.5	25.3	25.4	25.5	25.8	25.7	25.6	25.6
24	13.6 N	223.5	26.2	26.2	26.1	25.9	26.0	26.0	26.0	25.9	25.9	25.8	25.8
25	12.7 N	222.5	26.3	26.3	26.3	26.3	26.3	26.3	26.2	26.0	25.9	25.9	25.9
26	11.3 N	221.3	26.4	26.5	26.4	26.4	26.6	26.5	26.4	26.4	26.4	26.5	26.6
27	10.1 N	220.3	26.9	26.9	27.0	27.0	27.1	26.9	26.9	27.1	27.1	27.1	27.2
28	8.6 N	219.2	27.4	27.4	27.6	27.6	27.7	27.6	27.6	27.3	27.3	27.3	27.4
29	7.7 N	218.6	28.0	28.0	28.1	28.0	28.0	27.9	27.9	27.9	27.9	27.9	27.9
30	7.1 N	217.4	28.1	28.2	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.1	28.2
31	6.7 N	216.6	27.8	27.8	27.7	27.8	27.3	27.3	27.8	27.9	28.0	28.1	28.2
Nov. 1	5.8 N	215.3	28.1	28.2	28.1	28.1	28.1	28.0	28.0	28.0	28.0	28.0	28.0
2	4.9 N	213.2	28.0	27.8	27.8	27.9	27.9	27.9	27.8	27.8	27.8	27.7	27.7
3	4.3 N	210.7	26.6	26.6	26.6	26.8	27.2	27.3	27.6	27.6	27.7	27.7	27.7
4	3.0 N	210.2	27.7	27.7	27.7	27.8	27.7	27.7	27.6	27.6	27.5	27.5	27.6
5	0.8 N	208.5	27.5	27.4	27.3	27.3	27.2	27.1	27.1	26.8	26.3	26.3	26.3
6	1.8 S	207.6	26.7	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
7	4.9 S	206.6	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3
8	6.6 S	204.9	27.6	27.7	27.8	27.9	27.9	27.9	27.8	27.8	27.8	27.9	27.9
9	8.1 S	203.1	28.1	28.1	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3
10	9.0 S	201.9	28.3	28.4	28.4	28.3	28.3	28.3	28.3	28.3	28.2	28.2	28.2
11	9.4 S	200.9	28.3	28.3	28.4	28.4	28.3	28.3	28.3	28.3	28.3	28.4	28.5
12	10.3 S	198.9	28.3	28.3	28.4	28.4	28.4	28.4	28.4	28.4	28.4	28.3	28.4
13	11.0 S	198.0	28.6	28.6	28.5	28.5	28.6	28.6	28.5	28.5	28.5	28.4	28.3
14[d]	11.6 S	196.6	28.6	28.6	28.7	28.7	28.6	28.6	28.6	28.6	28.6	28.7	29.0

[a] Small, rapid fluctuations in temperature all during day; approaching San Francisco; overcast, light airs to calm. [b] Carnegie at San Francisco July 28-September 3; at Honolulu September 23-October 2. [c] Characteristic small, rapid fluctuations during late afternoon; light airs, clear to partly cloudy. [d] Highest

temperature, Carnegie, 1928-29--Concluded

local mean hour													Mean
11	12	13	14	15	16	17	18	19	20	21	22	23	
													°C
9.3	9.3	9.2	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.4	9.4	9.28
10.1	10.2	10.3	10.3	10.3	10.3	10.4	10.3	10.5	10.6	10.6	10.6	10.7	10.10
10.6	10.5	10.4	10.5	10.5	10.5	10.4	10.4	10.4	10.4	10.5	10.5	10.4	10.57
10.9	10.7	11.0	11.1	11.1	10.9	10.8	10.8	10.9	11.0	11.0	11.1	11.0	10.82
11.1	11.1	11.1	11.2	11.3	11.3	11.2	11.1	11.3	11.5	11.5	11.5	11.6	11.21
12.1	12.1	12.2	12.4	12.4	12.8	12.9	12.9	12.9	12.9	13.0	13.0	13.0	12.30
13.2	13.2	13.3	13.6	13.6	13.8	14.0	14.0	14.0	14.0	14.1	14.2	14.3	13.49
14.6	14.8	14.8	15.0	15.1	15.1	15.1	15.1	15.2	15.5	15.6	15.6	15.6	14.83
16.5	16.4	16.5	16.7	16.9	17.0	17.1	17.1	17.1	17.1	17.1	17.1	17.1	16.56
17.2	17.3	17.4	17.5	17.6	17.6	17.6	17.6	17.6	17.6	17.5	17.2	17.0	17.32
16.4	15.7	15.7	15.6	15.4	15.6	15.7	16.3	15.7	12.1	13.0	12.2	11.4	15.38
11.9	11.8	12.6	12.9	14.2	14.9	15.2	15.7	15.7	15.7	15.7	15.9	16.4	13.16
16.2	16.1	16.2	16.3	16.6	16.7	16.4	17.0	15.8	15.9	16.1	16.0	16.2	16.13
18.0	18.0	18.0	18.3	18.3	18.4	18.1	18.0	18.0	18.0	18.3	19.0	19.2	18.04
19.2	19.2	19.3	19.3	19.4	19.6	19.8	19.6	19.8	20.1	20.1	20.0	20.0	19.30
19.9	20.1	20.1	20.1	20.0	20.2	20.4	20.4	20.4	20.5	20.5	20.8	20.9	20.13
21.2	21.6	21.5	21.4	21.5	21.4	21.3	21.0	21.0	21.3	21.2	21.4	21.4	21.08
21.4	21.5	21.6	21.6	21.6	21.6	21.6	21.6	21.7	21.8	21.8	21.8	22.1	21.65
22.5	22.5	22.4	22.4	22.4	22.5	22.5	22.5	22.4	22.4	22.3	22.3	22.3	22.39
22.6	22.7	22.8	22.9	23.0	23.0	23.0	23.0	23.0	22.9	22.9	22.8	22.8	22.70
23.2	23.4	23.4	23.4	24.2	24.8	24.1	24.2	23.8	24.2	23.7	24.2	23.9	23.41
23.9	24.1	24.3	24.4	24.8	24.8	24.7	24.5	24.3	24.2	24.1	24.1	23.9	24.08
23.8	23.8	23.8	24.3	24.3	24.3	24.3	24.3	24.0	23.9	23.9	24.0	24.0	23.97
24.3	24.3	24.4	24.6	24.8	24.8	24.8	24.9	24.8	24.8	24.8	24.8	24.8	24.36
24.5	24.7	24.8	24.8	24.9	25.0	24.9	25.0	24.9	25.1	25.2	25.1	25.1	24.83
25.2	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.3	25.4	25.25
25.3	25.3	25.3	25.3	25.3	25.2	25.2	25.2	25.2	25.3	25.5	25.5	25.6	25.34
26.2	26.0	26.0	26.0	25.9	25.9	25.8	25.8	25.9	25.9	25.9	25.9	25.9	25.82
26.7	27.0	27.0	27.1	27.0	27.0	27.1	27.0	26.8	26.8	26.9	26.6	26.3	26.69
26.6	26.6	26.6	26.5	26.5	26.3	26.1	26.0	25.8	26.0	26.1	26.0	25.6	26.26
25.7	25.7	25.7	25.6	25.3	25.1	25.1	25.2	25.2	25.2	25.2	25.2	25.2	25.51
24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.43
24.2	24.4	24.3	24.4	24.3	24.3	23.8	23.8	23.7	23.7	23.5	23.5	23.3	24.03
23.2	23.3	23.3	23.2	23.2	22.7	22.3	22.5	22.5	22.7	22.9	22.8	22.8	22.93
22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.1	22.1	22.0	21.9	21.8	22.0	22.36
22.3	22.3	22.4	22.4	22.4	22.4	22.3	22.2	22.2	22.2	22.1	22.1	22.2	22.23
21.9	21.9	22.3	22.3	22.3	22.3	22.3	22.3	22.0	22.3	22.4	22.4	22.4	22.21
22.2	22.1	22.1	22.1	22.0	21.9	21.8	21.8	21.8	21.8	21.8	21.8	21.8	22.12
22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.9	22.9	22.9	22.9	22.9	22.73
23.4	23.6	23.7	23.8	24.1	24.2	24.1	23.9	23.7	23.3	23.6	23.5	23.5	23.48
23.5	23.8	23.8	23.9	23.9	23.8	23.7	23.5	23.3	23.4	23.3	23.4	23.4	23.43
23.9	23.8	23.9	23.9	23.9	23.9	23.7	23.7	23.6	23.6	23.6	23.7	23.7	23.75
23.4	23.6	23.6	23.6	23.6	23.3	23.3	23.3	23.2	23.3	23.4	23.5	23.6	23.49
24.7	24.6	24.4	24.3	24.2	24.2	24.3	24.3	24.3	24.5	24.8	24.8	25.1	24.36
25.6	25.6	25.8	25.4	25.3	25.3	25.3	25.5	25.5	25.7	25.9	26.0	26.1	25.56
25.9	26.1	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.3	26.4	26.4	26.3	26.14
25.9	25.9	25.9	25.8	26.0	26.2	26.1	26.2	26.3	26.3	26.4	26.4	26.4	26.15
26.8	26.9	27.2	27.2	27.1	26.9	26.9	26.8	26.8	26.8	26.8	26.8	26.9	26.71
27.2	27.8	27.8	27.9	27.8	27.8	27.6	27.5	27.3	27.3	27.2	27.3	27.4	27.30
27.8	27.9	28.0	28.2	28.2	28.1	28.2	27.9	27.9	27.9	28.0	27.9	28.0	27.76
28.0	28.1	28.1	28.1	28.1	28.1	28.1	28.0	28.1	28.1	28.1	28.1	28.1	28.03
28.2	28.2	28.1	28.2	28.2	28.2	28.1	28.1	28.0	28.0	28.0	27.8	27.8	28.09
28.3	28.3	28.3	28.3	28.3	28.5	28.5	28.3	28.2	28.0	28.0	28.0	28.0	28.03
28.0	28.0	28.0	28.1	28.1	28.1	28.1	28.1	28.0	28.0	28.0	28.0	28.0	28.05
27.7	27.6	27.6	27.5	27.4	27.3	27.2	26.9	26.8	26.8	26.6	26.7	26.3	27.44
27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.7	27.48
27.6	27.7	27.8	27.8	27.8	27.8	27.7	27.7	27.7	27.6	27.6	27.5	27.5	27.66
26.3	26.3	26.3	26.3	26.4	26.4	26.5	26.5	26.5	26.6	26.6	26.7	26.7	26.70
26.9	26.9	27.0	27.1	27.2	27.2	27.2	27.1	27.1	27.2	27.2	27.2	27.3	26.97
27.3	27.3	27.3	27.4	27.5	27.4	27.4	27.4	27.4	27.5	27.6	27.5	27.6	27.37
27.9	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	28.0	27.91
28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.28
28.2	28.2	28.2	28.3	28.3	28.2	28.2	28.2	28.2	28.3	28.2	28.2	28.2	28.25
28.6	28.6	28.6	28.7	28.7	28.6	28.6	28.6	28.5	28.5	28.3	28.3	28.4	28.45
28.5	28.5	28.6	28.6	28.7	28.8	28.8	28.7	28.7	28.6	28.6	28.6	28.6	28.52
28.4	28.3	28.4	28.6	28.7	28.7	28.6	28.6	28.6	28.6	28.6	28.6	28.6	28.54
29.3	29.7	30.1	30.2	30.2	30.1	29.3	29.3	29.2	29.1	29.1	29.0	28.8	29.11

sea-surface temperature of cruise recorded at 14h and 15h; approaching Pago Pago; clear and calm.
Note: Carnegie at Pago Pago November 18-27, and destroyed by fire in Apia harbor November 29, 1929.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 1: May 12, 1928; 38°14' N, 67°34' W; depth bottom, (4900) m; weather, c; sea, M; wind, N 4; conditions not very favorable; considerable drift; strong current to eastward; depths uncertain; depth of bottom from U. S. Hydrographic Office chart No. 1412, published March 1930																	
	0	24	....	....	....	...	....	...	....	0	24.00	36.23	24.59	24.59	0.0000	0.0000	0.00336
	4	24.17	36.23	24.54	....	...	8.16	34	....	5	24.15	36.23	24.54	24.56	0.0178	0.0170	341
h	20	24.16	36.22	24.54	....	...	8.16	24	....	25	24.15	36.22	24.54	24.65	0.0897	0.0853	342
15.5	39	24.06	36.25	24.59	....	...	8.17	31	....	50	23.90	36.30	24.67	24.90	0.1781	0.1693	330
30°	58	23.62	36.33	24.78	....	...	8.23	34	....	75	22.50	36.48	25.22	25.56	0.2583	0.2454	278
	78	22.14	36.52	25.35	....	...	8.17	39	....	100	20.85	36.57	25.75	26.20	0.325	0.308	229
	156	19.40	36.50	26.08	....	...	8.12	43	....	150	19.50	36.52	26.07	26.75	0.438	0.415	199
	234	16.19	36.20	26.64	....	...	8.06	78	....	200	17.15	36.25	26.45	27.36	0.535	0.507	165
										250	15.90	36.18	26.69	27.84	0.616	0.584	143
	126	20.05	36.58	25.96	....	...	8.14	42	....	300	15.45	36.10	26.74	28.11	0.692	0.654	140
h	168	18.51	36.43	26.25	....	...	8.09	44	....	400	14.35	35.69	26.66	28.49	0.846	0.800	151
16.8	210	16.82	36.22	26.51	....	...	8.08	61	....	500	12.80	35.42	26.78	29.09	1.001	0.946	140
45°	303	15.43	36.10	26.74	....	...	8.08	62	....	700	9.25	35.17	27.23	30.50	1.254	1.185	0.00099
	421	>9[a]	35.57	.....	....	...	8.04	96	....								
	631	>9[a]	35.25	.....	....	...	7.92	122	....								
	842	7.09	35.03	27.45	....	...	7.91	129	....								
Station 2: May 18, 1928; 39°06' N, 45°41' W; depth bottom, (3900) m; weather, cq; sea, R; wind, SSW 6; sea too rough for deeper series; sounding platform under water at times; depths uncertain; depth of bottom from U. S. Hydrographic Office chart No. 1412, published March 1930																	
	0	20.5	36.40	25.71	....	...	8.23	58	....	0	20.50	36.40	25.71	25.71	0.0000	0.0000	0.00229
	3	20.58	36.41	25.69	....	...	8.23	56	....	5	20.60	36.41	25.69	25.71	0.0121	0.0115	231
	22	20.56	36.41	25.70	....	...	8.23	39	....	25	20.55	36.41	25.70	25.81	0.0609	0.0578	231
h	40	20.57	36.43	25.71	....	...	8.21	46	....	50	20.55	36.43	25.72	25.95	0.1217	0.1151	228
11.7	58	20.57	36.43	25.71	....	...	8.16	31	....	75	20.35	36.41	25.76	26.10	0.1820	0.1721	227
50°	76	20.35	36.41	25.76	....	...	8.21	63	....	100	19.75	36.43	25.93	26.38	0.240	0.227	211
	142	18.56	36.47	26.27	....	...	8.18	26	....	150	18.45	36.47	26.30	26.98	0.343	0.323	177
	212	18.12	36.48	26.40	....	...	8.16	24	....	200	18.15	36.48	26.38	27.29	0.436	0.412	173
	297	17.79	36.43	26.44	....	...	8.16	31	....	250	18.00	36.46	26.41	27.55	0.526	0.497	171
	388	16.80	36.28	26.56	....	...	8.16	56	....	300	17.75	36.42	26.44	27.80	0.616	0.583	170
										400	16.50	36.25	26.61	28.42	0.789	0.747	0.00157
Station 3: May 21, 1928; 44°00' N, 36°10' W; depth bottom, 3738 m[b]; weather, bcq; sea, M; wind, SSE 3; fairly good conditions; drift estimated at 1.5 miles per hour																	
	0	.....[d]	36.06	.....	5.90	105	8.15	99	....	0	15.50	36.06	26.69	26.69	0.0000	0.0000	0.00136
	6	15.49	36.02	26.66	5.77	102	8.10	58	....	5	15.50	36.02	26.66	26.68	0.0073	0.0069	139
	29	15.36	36.02	26.69	5.90	104	8.14	142	....	25	15.40	36.02	26.69	26.80	0.0365	0.0345	137
h	59	14.66	35.96	26.81	5.65	99	8.19	30	....	50	14.95	35.98	26.75	26.98	0.0720	0.0679	130
13.1	89	13.79	35.91	26.95	5.26	90	8.10	50	....	75	14.00	35.93	26.92	27.27	0.1048	0.0987	116
23°	119	13.52	35.85	26.96	5.13	88	8.10	48	....	100	13.65	35.89	26.96	27.42	0.135	0.127	114
	240	12.91	35.79	27.04	5.26	89	8.11	53	....	150	13.30	35.83	26.99	27.68	0.194	0.183	111
	363	12.46	35.72	27.07	5.26	88	8.05	52	....	200	13.05	35.81	27.03	27.95	0.254	0.239	109
	488[c]	10.89	35.44	27.15	4.74	77	8.03	86	....	250	12.85	35.78	27.04	28.20	0.311	0.293	109
	620[c]	8.67	35.14	27.30	4.36	67	7.95	98	....	300	12.70	35.75	27.05	28.43	0.369	0.348	0.00110

[a] Thermometer off scale. [b] Mean of two sonic depths, 3733 and 3743 meters, at beginning and end of observations. [c] Depths uncertain.
[d] Temperature not read.

Table 2--Physical and chemical data and results of dynamic computations for <u>Carnegie</u> deep-sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 3--Continued																	
	423[a]	11.13	35.47	27.14	4.23	69	7.95	60	....	400	12.00	35.65	27.11	28.96	0.484	0.457	0.00107
	592[a]	8.35	35.10	27.32	4.23	65	7.95	84	....	500	10.15	35.32	27.20	29.52	0.594	0.560	098
11h.0	1125	4.54	34.97	27.72	5.65	79	7.88	74	....	700	7.40	35.04	27.41	30.70	0.784	0.737	080
43°	1300	4.11	34.95	27.76	5.65	79	7.90	160	....	1000	5.05	34.98	27.67	32.41	1.00	0.94	055
	1774	3.40	34.92	27.81	6.03	82	7.95	64	....	1500	3.80	34.94	27.78	34.91	1.27	1.20	045
	2292	3.21	34.89	27.80	6.09	83	7.92	62	....	2000	3.30	34.91	27.81	37.29	1.52	1.43	046
	2862	2.93	34.91	27.84	6.09	82	7.95	63	....	2500	3.10	34.90	27.82	39.62	1.76	1.65	047
										3000	2.90	34.90	27.84	41.96	2.02	1.90	0.00047
Station 4: May 23, 1928; 44°39' N, 33°06' W; depth bottom, 2439 m; weather, cq; sea, MC; wind, ESE 4; wind increasing during observations; considerable side drift; depths uncertain																	
	0	14.62	35.93	26.79	....	...	8.16	92	....	0	14.62	35.93	26.79	26.79	0.0000	0.0000	0.00127
12h.4	5	14.65	35.94	26.79	....	...	8.15	23	....	5	14.65	35.94	26.79	26.81	0.0067	0.0064	127
26°	26	14.69	36.03	26.85	....	...	8.12	23	....	25	14.70	36.03	26.84	26.95	0.0331	0.0314	123
	52	14.32	36.00	26.91	....	...	8.15	21	....	50	14.35	36.01	26.91	27.14	0.0648	0.0611	115
	78	13.69	35.92	26.98	....	...	8.12	40	....	75	13.80	35.94	26.97	27.32	0.0949	0.0896	112
	103	13.37	35.88	27.01	....	...	8.12	50	....	100	13.40	35.89	27.01	27.47	0.124	0.117	109
										150	12.50	35.75	27.09	27.79	0.179	0.170	102
	82	13.74	35.92	26.97	....	...	8.14	...	....	200	11.95	35.65	27.12	28.05	0.233	0.221	101
	147	12.53	35.75	27.08	....	...	8.06	34	....	250	11.70	35.63	27.15	28.31	0.285	0.270	099
11h.0	210	11.89	35.64	27.12	....	...	8.12	46	....	300	11.50	35.60	27.17	28.56	0.337	0.320	0.00099
45°	268	11.64	35.62	27.16	....	...	8.06	51	....								
	327	11.32	35.57	27.18	....	...	8.11	59	....								
	....[b]	13.36	35.88	27.01	....	...	8.14	...	....								
	....[b]	11.95	35.69	27.15	....	...	8.12	...	....								
Station 5: May 25, 1928; 43°15' N, 31°32' W; depth bottom, >2719 m; weather, bc; sea, RC; wind, NE 4; fairly good conditions; wind and sea increased toward end																	
	0	15.05	35.89	26.66	....	...	8.19	16	....	0	15.05	35.89	26.66	26.66	0.0000	0.0000	0.00139
h	5	15.06	35.89	26.66	....	...	8.23	13	....	5	15.06	35.89	26.66	26.68	0.0073	0.0070	139
12.4	27	15.04	35.89	26.66	....	...	8.23	19	....	25	15.05	35.89	26.66	26.77	0.0369	0.0349	140
<15°	53	14.52	36.00	26.87	....	...	8.21	36	....	50	14.60	36.00	26.85	27.08	0.0715	0.0675	121
	80	13.83	35.90	26.93	....	...	8.17	56	....	75	13.90	35.93	26.94	27.29	0.1028	0.0970	114
	106	13.51	35.90	27.00	....	...	8.15	27	....	100	13.55	35.89	26.98	27.44	0.132	0.125	112
										150	13.20	35.87	27.05	27.74	0.190	0.179	105
	106	13.51	35.88	26.98	....	...	8.10	29	....	200	13.10	35.84	27.04	27.96	0.247	0.233	108
	211	13.08	35.83	27.04	....	...	8.12	90?	....	250	12.95	35.81	27.05	28.21	0.304	0.286	108
	320[c]	12.67	35.76	27.06	....	...	8.12	34	....	300	12.75	35.77	27.06	28.44	0.362	0.341	110
h	430	12.30	35.69	27.08	....	...	8.12	43	....	400	12.40	35.71	27.08	28.92	0.478	0.452	110
11.0	539	11.69	35.57	27.11	....	...	8.08	46	....	500	11.95	35.62	27.10	29.41	0.595	0.561	109
38°	751	9.86	35.31	27.24	....	...	7.97	84	....	700	10.40	35.36	27.18	30.43	0.823	0.775	105
	1078	6.19	35.15	27.66	....	...	7.94	63	....	1000	7.00	35.18	27.58	32.28	1.10	1.03	67
	1623	3.96	34.94	27.77	....	...	7.97	54	....	1500	4.20	34.98	27.77	34.88	1.41	1.33	48
	2170	3.28	34.90	27.80	....	...	7.99	64	....	2000	3.45	34.90	27.78	37.25	1.68	1.57	49
	2719	3.09	34.90	27.82	....	...	8.03	56	....	2500	3.15	34.90	27.82	39.62	1.93	1.81	0.00047

[a]Depths uncertain. [b]Water-bottles reversed when hauling up, messengers probably caught on wire for some time. [c]Water-bottle not locked

Table 2--Physical and chemical data and results of dynamic computations for <u>Carnegie</u> deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 6: May 31, 1928; 50°22' N, 13°31' W; depth bottom, 2604 m; weather, or; sea, MS; wind, E 0-1; good conditions; little wind and sea fairly smooth																	
	0	12.44	35.55	26.95	....	...	8.15	21	....	0	12.44	35.55	26.95	26.95	0.0000	0.0000	0.00112
h	5	12.45	35.52	26.92	....	...	8.15	17	....	5	12.45	35.55	26.94	26.96	0.0059	0.0057	112
13.1	26[a]	12.36	35.59	26.99	....	...	8.13	26	....	25	12.40	35.55	26.96	27.08	0.0295	0.0280	111
12°	52	11.62	35.51	27.07	....	...	8.12	32	....	50	11.65	35.55	27.10	27.34	0.0571	0.0541	098
	78	11.59	35.59	27.14	....	...	8.11	33	....	75	11.60	35.55	27.11	27.46	0.0830	0.0788	099
	104	11.28	35.52	27.15	....	...	8.08	41	....	100	11.30	35.55	27.16	27.63	0.108	0.103	094
										150	10.90	35.53	27.22	27.92	0.156	0.148	088
	103	11.20	35.58	27.21	....	...	8.08	40	....	200	10.70	35.51	27.25	28.18	0.204	0.193	088
	199	10.71	35.51	27.24	....	...	8.05	42	....	250	10.60	35.51	27.26	28.43	0.249	0.236	088
	301	10.52	35.50	27.27	....	...	8.04	54	....	300	10.50	35.50	27.27	28.67	0.296	0.281	089
h	400[a]	10.37	35.47	27.27	....	...	8.03	56	....	400	10.35	35.47	27.28	29.15	0.389	0.371	090
11.9	500	10.24	35.50	27.32	....	...	8.03	57	....	500	10.25	35.50	27.32	29.65	0.483	0.459	087
18°	702	9.63	35.24[b]	.....	....	...	7.99	69	....	700	9.65	35.51	27.43	30.69	0.661	0.626	080
	1007	8.49	35.51	27.62	....	...	7.94	79	....	1000	8.50	35.52	27.63	32.29	0.89	0.84	064
	1521	4.98	35.12	27.80	....	...	7.94	84	....	1500	5.05	35.13	27.79	34.88	1.20	1.13	049
	2038	3.28	34.91	27.81	....	...	7.94	79	....	2000	3.35	34.92	27.81	37.29	1.46	1.37	046
	2555	2.99	34.96	27.88	....	...	7.95	88	....	2500	3.00	34.90	27.83	39.64	1.70	1.60	0.00046
Station 7: July 13, 1928; 63°20' N, 9°25' W; depth bottom, 454 m; weather, qor; sea, R; wind, SW by S 7; not good conditions; gale and rough sea; lower water-bottle on bottom, partly filled with mud and sand																	
	0	8.92	35.21	27.31	....	...	8.08	34	....	0	8.92	35.21	27.31	27.31	0.0000	0.0000	0.00078
	9	8.92	35.21	27.31	....	...	8.08	34	....	5	8.92	35.21	27.31	27.33	0.0041	0.0039	78
	33	8.90	35.23	27.33	....	...	8.07	34	....	25	8.90	35.22	27.33	27.45	0.0203	0.0194	76
h	54	8.16	35.25	27.46	....	...	8.03	47	....	50	8.20	35.25	27.46	27.70	0.0387	0.0368	64
13.7	75	8.12	35.23	27.45	....	...	8.04	53	....	75	8.12	35.23	27.45	27.80	0.0559	0.0532	66
57°	97	8.12	35.24	27.46	....	...	8.04	57	....	100	8.10	35.24	27.46	27.93	0.073	0.070	66
	183	7.79	35.26	27.53	....	...	8.04	63	....	150	7.95	35.26	27.50	28.21	0.106	0.101	62
	271	5.95	35.04	27.61	....	...	7.99	63	....	200	7.60	35.22	27.53	28.47	0.139	0.133	61
	361	2.72	34.95	27.89	....	...	7.93	64	....	250	6.60	35.08	27.55	28.73	0.170	0.162	58
	454	0.31	34.92[c]	28.04	....	...	7.84	...	....	300	5.00	35.00	27.70	29.13	0.198	0.188	45
										400	1.65	34.94	27.97	29.91	0.230	0.219	0.00017
Station 8: July 15, 1928; 63°30' N, 14°41' W; depth bottom, 1308 m; weather, b; sea, S; wind, calm; good conditions																	
	0	10.32	35.23	27.09	6.11	98	7.93	13	....	0	10.32	35.23	27.09	27.09	0.0000	0.0000	0.00099
	5	10.22	35.22	27.10	6.48	104	8.01	16	....	5	10.22	35.22	27.10	27.12	0.0052	0.0050	98
	25	9.72	35.23	27.20	6.24	99	8.02	21	....	25	9.72	35.23	27.20	27.32	0.0248	0.0236	88
	50	9.08	35.25	27.32	6.42	100	7.95	27	....	50	9.08	35.25	27.32	27.56	0.0466	0.0442	77
h	75	8.60	35.26	27.40	6.29	97	7.95	51	....	75	8.60	35.26	27.40	27.75	0.0661	0.0628	71
9.1	100	8.44	35.25	27.42	6.17	95	7.95	54	....	100	8.44	35.26	27.43	27.90	0.084	0.080	68
9°	200	8.12	35.28	27.49	6.17	94	7.94	60	....	150	8.25	35.26	27.46	28.17	0.119	0.113	66
	300	8.06	35.25	27.48	5.98	91	7.93	73	....	200	8.12	35.26	27.48	28.42	0.155	0.147	66
	400	7.98	35.27	27.51	6.11	93	7.94	70	....	250	8.10	35.26	27.48	28.66	0.189	0.179	66
	500	7.95	35.23	27.48	5.80	88	7.93	83	....	300	8.06	35.26	27.49	28.90	0.224	0.213	66
	700	7.57	35.24	27.54	5.86	89	7.91	74	....	400	7.98	35.26	27.50	29.38	0.294	0.280	67
	1000	4.24	35.09	27.85	6.24	87	7.93	54	....	500	7.95	35.25	27.50	29.85	0.366	0.347	68
										700	7.57	35.24	27.54	30.83	0.510	0.483	68
										1000	4.24	35.10	27.86	32.62	0.67	0.64	0.00035

[a] Water bottles not locked. [b] Salinity (35.24) regarded as erroneous. [c] By titration.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 9: July 28, 1928; 62°45' N, 25°52' W; depth bottom, 882 m; weather, b; sea, M; wind, NNE 4; fairly good conditions																	
h	0	11.12	35.14	26.88	....	...	8.08	20	....	0	11.12	35.14	26.88	26.88	0.0000	0.0000	0.00118
8.9	8	11.09	35.11	26.86	....	...	8.08	20	....	5	11.10	35.12	26.87	26.89	0.0063	0.0059	118
50°	31	10.72	35.04	26.88	....	...	8.06	28	....	25	10.90	35.05	26.85	26.97	0.0317	0.0298	121
	56	8.06	35.11	27.37	....	...	7.96	55	....	50	8.35	35.11	27.31	27.55	0.0580	0.0547	078
	83	7.54	35.07	27.42	....	...	7.99	55	....	75	7.75	35.07	27.37	27.72	0.0780	0.0738	074
										100	7.55	35.10	27.44	27.91	0.096	0.091	067
	109	7.62	35.11	27.44	....	...	7.98	56	....	150	7.40	35.12	27.48	28.19	0.131	0.124	064
h	208	7.32	35.12	27.48	....	...	7.93	58	....	200	7.30	35.12	27.49	28.43	0.165	0.156	064
9.4	304	7.20	35.11	27.50	....	...	7.99	58	....	250	7.25	35.12	27.50	28.68	0.198	0.188	063
50°	452	6.80	35.08	27.53	....	...	7.95	58	....	300	7.20	35.11	27.50	28.92	0.232	0.220	065
	587	6.00	35.08	27.63	....	...	7.97	58	....	400	6.95	35.09	27.52	29.41	0.300	0.285	064
	882 a)	5.37	35.00	27.65	....	...	7.93	58	....	500	6.55	35.08	27.57	29.93	0.367	0.346	059
										700	5.65	35.06	27.66	30.98	0.488	0.459	0.00054
Station 10: July 30, 1928; 59°19' N, 34°15' W; depth bottom, 3031 m; weather, c; sea, M; wind, WNW 1-2; good conditions																	
	0	10.94	34.95	26.77	....	...	8.08	28	....	0	10.94	34.95	26.77	26.77	0.0000	0.0000	0.00129
	9	10.94	35.05	26.84	....	...	8.12	28	....	5	10.94	35.02	26.82	26.84	0.0067	0.0063	123
h	30	10.32	34.93	26.86	....	...	8.06	29	....	25	10.55	34.93	26.82	26.94	0.0329	0.0310	124
11.5	54	9.86	34.94	27.96	....	...	8.04	34	....	50	10.05	34.94	26.92	27.16	0.0644	0.0608	114
18°	84	7.19	34.98	27.40	....	...	7.99	56	....	75	7.80	34.96	27.29	27.64	0.0903	0.0854	082
	105	6.56 c)	35.02	27.52	....	...	7.95	52	....	100	6.65	35.02	27.50	27.97	0.109	0.103	062
	207	5.62	35.00	27.62	....	...	7.93	55	....	150	6.00	35.02	27.59	28.30	0.139	0.131	052
	308	5.01	34.95	27.66	....	...	7.92	58	....	200	5.65	35.00	27.62	28.57	0.167	0.158	051
										250	5.35	34.98	27.62	28.82	0.194	0.183	050
	334	5.26	34.93	27.61	....	...	7.91	58	....	300	5.15	34.96	27.64	29.07	0.220	0.208	050
h	445	4.69	34.89	27.64	....	...	7.89	60	....	400	4.80	34.90	27.64	29.55	0.273	0.259	051
10.1	554	4.54	34.89	27.66	....	...	7.89	60	....	500	4.60	34.89	27.64	30.03	0.328	0.310	051
18°	773	3.80	34.93	27.77	....	...	7.88	60	....	700	4.10	34.91	27.74	31.08	0.429	0.405	044
	1101	3.45	34.83	27.73	....	...	7.88	60	....	1000	3.45	34.88	27.75	32.53	0.57	0.54	043
	1636	3.25	34.93	27.83	....	...	7.88	60	....	1500	3.30	34.92	27.82	34.97	0.79	0.75	040
	2174	3.14	34.88	27.80	....	...	7.88	60	....	2000	3.20	34.90	27.80	37.28	1.03	0.97	046
	2718	2.98	34.96	27.87	....	...	7.88	60	....	2500	3.10	34.91	27.83	39.63	1.27	1.19	047
	3031 b)	2.53	.....	.....	....	...	7.85	62	....	3000	2.65	34.95	27.90	42.04	1.51	1.42	0.00041
Station 11: August 1, 1928; 58°12' N, 35°51' W; depth bottom, 2633 m; weather, fc; sea, ML; wind, WSW; vessel rolling heavily in southwest swell; nearly calm; thick fog																	
	0	10.67	34.91	26.78	....	...	8.06	27	....	0	10.67	34.91	26.78	26.78	0.0000	0.0000	0.00128
	9	10.63	34.91	26.79	....	...	8.06	25	....	5	10.65	34.91	26.79	26.82	0.0067	0.0064	127
h	30	9.68	34.91	26.95	....	...	8.02	28	....	25	10.00	34.91	26.91	27.03	0.0322	0.0306	115
10.5	55	7.01 c)	34.97	27.42	....	...	7.92	63	....	50	7.30	34.95	27.36	27.60	0.0571	0.0541	073
23°	81	6.42	35.08	27.58	....	...	7.91	59	....	75	6.55	35.07	27.56	27.91	0.0742	0.0703	056
	107	6.26	35.05	27.58	....	...	7.90	67	....	100	6.30	35.06	27.58	28.05	0.088	0.084	053
	214	5.52	34.97	27.60	....	...	7.88	66	....	150	5.95	35.00	27.58	28.29	0.117	0.110	053
	323	5.02	34.97	27.67	....	...	7.88	67	....	200	5.60	34.97	27.60	28.55	0.146	0.137	0.00053

a) Water-bottle on bottom, sand in sample. b) Water-bottle on bottom, mud in sample. c) Temperature from pressure thermometer and wire depth.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 11--Continued																	
	392	4.58	34.93	27.69	....	...	7.89	66	....	250	5.35	34.97	27.62	28.82	0.173	0.162	0.00050
	486a)	4.52	35.02	27.76	....	...	7.88	...	....	300	5.10	34.97	27.66	29.09	0.199	0.187	049
h	581	4.24	34.91	27.71	....	...	7.88	67	....	400	4.70	34.93	27.67	29.58	0.249	0.237	049
9.2	675a)	4.68	34.92	27.67	....	...	7.87	70	....	500	4.40	34.91	27.69	30.08	0.300	0.284	046
25°	775	3.80	34.95	27.79	....	...	7.77	51	....	700	4.00	34.93	27.75	31.09	0.395	0.373	043
	971	3.50	34.88	27.76	....	...	7.87	62	....	1000	3.50	34.87	27.76	32.54	0.53	0.50	043
	1265	3.47	34.91	27.79	....	...	7.87	64	....	1500	3.45	34.93	27.81	34.95	0.76	0.72	042
	1770	3.28	34.93	27.83	....	...	7.89	67	....	2000	3.20	34.91	27.82	37.30	1.00	0.94	0,00044
	2311	3.08	34.92	27.84	....	...	7.88	68	....								
Station 12: August 5, 1928; 51°40' N, 49°32' W; depth bottom, 2792 m; weather, bc; sea, CL; wind, N 4; not very good conditions; vessel rolling heavily; one wave over quarter-deck																	
	0	8.44	33.65	26.16	....	...	8.10	27	....	0	8.44	33.65	26.16	26.16	0.0000	0.0000	0.00187
	10	8.41	33.63	26.15	....	...	8.10	27	....	5	8.40	33.64	26.16	26.19	0.0098	0.0094	187
h	41	4.18	34.51	27.40	....	...	7.96	78	....	25	6.50	33.95	26.68	26.80	0.0439	0.0418	137
11.0	100	3.46	34.87	27.76	....	...	7.91	95	....	50	3.95	34.74	27.61	27.86	0.0685	0.0650	049
18°	137	3.42	34.83	27.73	....	...	7.89	80	....	75	3.60	34.86	27.74	28.10	0.0799	0.0760	038
	174	3.41	34.90	27.79	....	...	7.89	82	....	100	3.45	34.87	27.76	28.24	0.089	0.085	036
	321	3.39	34.85	27.75	....	...	7.88	86	....	150	3.40	34.84	27.74	28.47	0.108	0.103	037
										200	3.40	34.89	27.78	28.74	0.128	0.122	034
	288	3.37	34.85	27.75	....	...	7.88	87	....	250	3.40	34.86	27.76	28.97	0.146	0.139	036
	435	3.32	34.85	27.76	....	...	7.91	105	....	300	3.35	34.85	27.76	29.20	0.166	0.157	037
h	582	3.30	34.85	27.76	....	...	7.90	91	....	400	3.35	34.85	27.76	29.69	0.206	0.195	038
9.6	732	3.24	34.87	27.78	....	...	7.90	90	....	500	3.30	34.85	27.76	30.17	0.247	0.233	038
30°	1031	3.08	34.88	27.81	....	...	7.98	90	....	700	3.25	34.86	27.77	31.13	0.329	0.311	040
	1481	3.11	34.88	27.80	....	...	7.98	91	....	1000	3.10	34.88	27.80	32.59	0.45	0.43	037
	2221	2.62	34.89	27.85	....	...	7.98	90	....	1500	3.10	34.88	27.80	34.96	0.66	0.63	041
	2792b)	2.41	.....	.....	....	...	7.95	138	....	2000	2.75	34.89	27.84	37.34	0.89	0.84	040
										2500	2.55	34.89	27.86	39.70	1.10	1.03	0.00042
Station 13: August 7, 1928; 46°06' N, 48°01' W; depth bottom, 126 m; weather, b; sea, SL; wind, W 2-3; good conditions																	
	0	11.27	32.68	24.94	....	...	....	...	....	0	11.30	32.66	24.92	24.92	0.0000	0.0000	0.00304
h	7	11.20	32.67	24.95	....	...	....	...	....	5	11.25	32.67	24.92	24.95	0.0160	0.0153	304
9.4	27c)	....	33.22	.....	....	...	....	...	....	25	0.75	33.18	26.62	26.74	0.0631	0.0600	143
8°	51	- 1.64	33.40	26.90	....	...	....	...	....	50	- 1.60	33.39	26.88	27.13	0.0975	0.0924	117
	77	- 1.52	33.47	26.95	....	...	....	...	....	75	- 1.50	33.50	26.97	27.35	0.1274	0.1209	110
	127	- 0.80	33.69	27.11	....	...	....	...	....	100	- 1.20	33.60	27.05	27.55	0.155	0.147	0.00101
	0	11.40	32.64	24.89	....	...	8.09	19	....								
	3	11.34	32.66	24.92	....	...	8.10	19	....								
h	6	11.33	32.69	24.94	....	...	8.09	19	....								
9.8	16	10.33	32.70	25.12	....	...	8.08	19	....								
8°	26	0.72	33.11	26.57	....	...	8.01	31	....								
	51	- 1.59	33.40	26.89	....	...	7.87	59	....								
	76	- 1.54	33.52	26.99	....	...	7.87	59	....								
	126	- 0.71	33.72	27.12	....	...	7.87	63	....								

[a] Water-bottles probably reversed at wrong levels since depths by thermometers are wrong. [b] Water-bottle on bottom. [c] Thermometers off scale.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 14: August 9, 1928; 42°10' N, 47°19' W; depth bottom, 4154 m; weather, bc; sea, SL; wind, NE 1-2; good conditions																	
	0	21.18	35.23	24.64	....	...	8.18	11	....	0	21.18	35.23	24.64	24.64	0.0000	0.0000	0.00331
	8	21.16	35.20	24.62	....	...	8.19	12	....	5	21.15	35.21	24.63	24.65	0.0175	0.0166	331
	26	21.07	35.36	24.77	....	...	8.21	12	....	25	21.05	35.36	24.77	24.88	0.0862	0.0817	320
h	49	14.95	35.10	26.08	....	...	8.18	16	....	50	14.95	35.10	26.08	26.31	0.1541	0.1459	194
11.2	72	15.04	35.68	26.51	....	...	8.14	28	....	75	15.05	35.68	26.50	26.85	0.2005	0.1898	156
28°	95	14.02	35.59	26.66	....	...	8.06	34	....	100	14.00	35.57	26.65	27.11	0.240	0.227	143
	186	13.66[a]	35.40	26.59	....	...	8.04	87	....	150	13.85	35.46	26.59	27.28	0.317	0.300	150
	277	11.99	35.51[b]	.....	....	...	7.97	117	....	200	13.40	35.38	26.62	27.54	0.396	0.375	148
	368	9.32	35.17	27.22	....	...	7.91	139	....	250	12.50	35.31	26.76	27.92	0.471	0.446	136
	459	7.77	35.08	27.39	....	...	7.88	146	....	300	11.35	35.25	26.92	28.31	0.539	0.510	121
										400	8.65	35.13	27.30	29.17	0.649	0.615	087
	492	6.83	34.98	27.44	....	...	7.88	176	....	500	6.80	35.02	27.48	29.84	0.733	0.693	069
	693	4.40	34.87	27.66	....	...	7.88	153	....	700	4.35	34.87	27.67	31.01	0.860	0.813	051
h	990	3.73	34.88	27.74	....	...	7.91	143	....	1000	3.70	34.88	27.74	32.51	1.01	0.96	045
9.8	1488	3.34	34.89	27.79	....	...	7.91	137	....	1500	3.30	34.89	27.79	34.94	1.25	1.18	043
18°	1985	3.25	34.90	27.80	....	...	7.90	134	....	2000	3.25	34.90	27.80	37.28	1.50	1.41	046
	2483	3.10	34.91	27.83	....	...	7.88	134	....	2500	3.10	34.91	27.83	39.63	1.74	1.64	047
	3001	2.92	34.90	27.84	....	...	7.90	139	....	3000	2.90	34.90	27.84	41.96	1.99	1.88	048
	3519	2.50	34.89	27.86	....	...	7.90	131	....	3500	2.55	34.89	27.86	44.29	2.24	2.12	047
	4061	2.22	34.89	27.89	....	...	7.90	142	....	4000	2.25	34.89	27.89	46.60	2.48	2.34	0.00043
Station 15: August 11, 1928; 38°39' N, 48°48' W; depth bottom, 5408 m; weather, b; sea, ML; wind, WNW 1-2; fairly good conditions; vessel rolling heavily																	
	0	24.81	36.39	24.47	....	...	8.21	11	....	0	24.81	36.39	24.47	24.47	0.0000	0.0000	0.00348
	10	24.54	36.39	24.55	....	...	8.22	8	....	5	24.70	36.39	24.50	24.53	0.0182	0.0173	344
	33	21.66	36.49	25.46	....	...	8.22	9	....	25	23.00	36.46	25.06	25.17	0.0852	0.0810	292
	62	19.27	36.47	26.12	....	...	8.21	8	....	50	19.80	36.48	25.96	26.19	0.1510	0.1432	206
h	91	18.56	36.45	26.26	....	...	8.19	13	....	75	18.85	36.46	26.19	26.53	0.2029	0.1923	186
12.8	120	18.25	36.47	26.35	....	...	8.20	19	....	100	18.45	36.45	26.28	26.73	0.251	0.238	178
26°	235	17.96	36.45	26.41	....	...	8.17	19	....	150	18.10	36.47	26.39	27.07	0.343	0.324	169
	352	17.82	36.42	26.42	....	...	8.17	20	....	200	18.00	36.46	26.41	27.31	0.433	0.409	169
	468	17.44	36.36	26.46	....	...	8.15	24	....	250	17.95	36.45	26.42	27.56	0.523	0.493	169
	585	16.32	36.20	26.61	....	...	8.08	31	....	300	17.85	36.43	26.42	27.78	0.613	0.579	171
	816	13.29	35.72	26.91	....	...	8.03	86	....	400	17.65	36.40	26.44	28.25	0.795	0.751	172
	912	11.28	35.47	27.11	....	...	7.96	109	....	500	17.25	36.32	26.49	28.76	0.979	0.921	169
										700	14.90	35.99	26.77	29.96	1.319	1.238	148
	380	17.62	.....	.....	....	...	8.16	20	....	1000	9.55	35.33	27.30	31.94	1.71	1.61	098
	749	.....[c]	36.03	.....	....	...	8.06	58	....	1500	4.80	35.01	27.73	34.83	2.12	1.99	054
	994	13.70[d]	35.78	26.86	....	...	8.03	88	....	2000	3.70	34.94	27.79	37.25	2.40	2.26	050
	1421	6.75	35.13	27.57	....	...	7.89	131	....	2500	3.40	34.93	27.81	39.60	2.66	2.50	050
h	1863	3.87	34.95	27.78	....	...	7.92	113	....	3000	3.15	34.93	27.84	41.94	2.93	2.76	049
10.4	2327	3.47	34.93	27.81	....	...	7.91	94	....	3500	2.80	34.91	27.85	44.26	3.18	3.00	048
46°	2809	3.27	34.96	27.85	....	...	7.91	98	....	4000	2.50	34.91	27.88	46.57	3.44	3.23	046
	3295	2.96	34.91	27.84	....	...	7.90	118	....	4500	2.40	34.87	27.86	48.81	3.69	3.47	0.00051
	3795	2.58	34.91	27.87	....	...	7.91	163	....								
	4319	2.41	34.89	27.87	....	...	7.88	173	....								
	4841	2.36	34.85	27.84	....	...	7.88	178	....								

[a] Temperature from pressure thermometer and wire depth. [b] Water-bottle not locked; salinity rejected. [c] Thermometer off scale.
[d] Temperature (11°.10) by second thermometer rejected; bottles probably reversed on way down at about 800 and 1200 meters instead of at 994 and 1421 meters.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 16: August 13, 1928; 36°47' N, 46°31' W; depth bottom, 5287 m; weather, bc; sea, C; wind, SW 5; fair conditions; fresh breeze																	
	0	25.92	36.16	23.95	....	...	8.24	8	....	0	25.92	36.16	23.95	23.95	0.0000	0.0000	0.00397
	8	25.88	36.16	23.96	....	...	8.24	8	....	5	25.90	36.16	23.96	23.99	0.0209	0.0199	395
	30	25.81	36.17	24.00	....	...	8.23	8	....	25	25.85	36.17	23.98	24.09	0.1041	0.0988	395
	55	23.64	36.41	24.84	....	...	8.23	8	....	50	24.40	36.38	24.58	24.81	0.2006	0.1905	338
h	82	21.22	36.51	25.60	....	...	8.18	12	....	75	21.85	36.51	25.43	25.77	0.2792	0.2650	258
10.8	103	19.62	36.48	26.01	....	...	8.17	13	....	100	19.90	36.49	25.94	26.39	0.341	0.323	210
28°	196	17.37	36.31	26.45	....	...	8.16	13	....	150	18.35	36.40	26.27	26.95	0.444	0.421	180
	381	15.30	36.11	26.78	....	...	8.06	56	....	200	17.60	36.34	26.41	27.31	0.538	0.509	169
	746	8.80[a]	35.12	27.27	....	...	7.85	143	....	250	17.00	36.28	26.51	27.65	0.625	0.590	160
	1242	4.80	34.99	27.71	....	...	7.88	118	....	300	16.40	36.23	26.61	27.97	0.708	0.669	153
	1690	3.57	34.92	27.79	....	...	7.88	105	....	400	15.05	36.06	26.80	28.62	0.863	0.814	137
										500	12.60	35.57	26.93	29.23	1.004	0.945	124
	265	17.10	36.30	26.50	....	...	8.10	32	....	700	8.90	35.13	27.25	30.52	1.241	1.167	098
h	383	15.40[b]	36.10	26.75	....	...	8.05	50	....	1000	6.10	35.02	27.58	32.30	1.50	1.41	065
9.7	489	.....	35.55	.....	....	...	8.02	70	....	1500	4.00	34.95	27.77	34.89	1.80	1.70	047
32°	596	10.52	35.34	27.14	....	...	7.88	134	....	2000	3.30	34.90	27.80	37.28	2.06	1.94	0.00047
	726	8.00	35.06	27.34	....	...	7.85	143	....								
Station 17: August 15, 1928; 33°42' N, 42°21' W; depth bottom, 4492 m; weather, bc; sea, C; wind, SW 5; poor conditions; vessel rolling, pitching, and drifting																	
	0	26.19	36.58	24.18	....	...	8.29	9	....	0	26.19	36.58	24.18	24.18	0.0000	0.0000	0.00375
	6	26.19	36.55	24.16	....	...	8.27	17	....	5	26.19	36.55	24.16	24.18	0.0198	0.0189	377
h	18	25.82	36.59	24.31	....	...	8.28	12	....	25	24.20	36.59	24.80	24.91	0.0929	0.0882	317
10.0	35	23.05[a]	.....	.....	....	...	8.28	12	....	50	21.90	36.60	25.48	25.71	0.1679	0.1592	251
45°	53	21.85	36.60	25.49	....	...	8.27	12	....	75	20.50	36.63	25.89	26.23	0.2296	0.2174	214
	73	20.65	36.64	25.86	....	...	8.23	9	....	100	19.30	36.54	26.14	26.59	0.283	0.268	191
	91	19.82	36.60	26.05	....	...	8.23	11	....	150	18.10	36.44	26.37	27.05	0.379	0.358	171
	113	19.05	.....	.....	....	...	8.18	7	....	200	17.75	36.40	26.42	27.33	0.469	0.444	169
	133	18.38	.....	.....	....	...	8.18	8	....	250	17.60	36.37	26.44	27.58	0.558	0.528	168
										300	17.25	36.31	26.48	27.85	0.646	0.611	165
	75	20.34	36.62	25.92	....	...	8.23	7	....	400	15.85	36.14	26.68	28.51	0.812	0.768	148
	87	19.56	36.53	26.06	....	...	8.23	5	....	500	14.15	35.87	26.85	29.13	0.964	0.910	135
h	176	17.89	36.42	26.40	....	...	8.18	11	....	700	10.20	35.36	27.22	30.48	1.215	1.146	0.00101
9.2	268	17.49	36.35	26.44	....	...	8.17	13	....								
50°	363	16.40	36.22	26.61	....	...	8.11	15	....								
	459	14.84	35.99	26.78	....	...	8.08	54	....								
	645[c]	11.14	35.47	27.14	....	...	8.00	72	....								
	...	12.34	35.68	27.07	....	...	8.01	67	....								
Station 18: August 17, 1928; 29°47' N, 40°36' W; depth bottom, 4054 m; weather, b; sea, S; wind, NNE 2; good conditions																	
	0	26.98	37.00	24.25	....	...	8.23	5	....	0	26.98	37.00	24.25	24.25	0.0000	0.0000	0.00368
h	5	26.99	37.02	24.26	....	...	8.25	5	....	5	26.99	37.02	24.26	24.28	0.0194	0.0185	368
11.0	14	26.76	.....	.....	....	...	8.26	5	....	25	25.95	36.97	24.56	24.67	0.0939	0.0892	340
15°	26	25.93	36.97	24.56	....	...	8.25	5	....	50	22.35	36.82	25.52	25.75	0.1714	0.1626	247
	39	23.76	.....	.....	....	...	8.23	5	....	75	20.85	36.81	25.94	26.28	0.2320	0.2197	0.00209

[a] Temperature from pressure thermometer and wire depth. [b] Thermometer off scale. [c] Water bottle reversed at wrong level.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 18--Continued																	
h	51	22.12	36.82	25.58	....	...	8.24	5	....	100	20.35	36.81	26.06	26.51	0.286	0.270	0.00199
11.0	77	20.84	36.81	25.94	....	...	8.20	5	....	150	19.25	36.73	26.29	26.97	0.386	0.364	178
15°	103	20.32	36.81	26.07	....	...	8.21	5	....	200	18.35	36.48	26.33	27.24	0.481	0.454	177
	208	18.20	36.46	26.36	....	...	8.21	8	....	250	17.55	36.35	26.43	27.57	0.571	0.540	169
	311	16.74	36.25	26.55	....	...	8.18	74	....	300	16.80	36.26	26.55	27.92	0.658	0.622	159
										400	15.55	36.11	26.72	28.54	0.819	0.774	144
	296	16.81	36.25	26.54	....	...	8.16	28	....	500	14.25	35.91	26.85	29.14	0.969	0.913	133
	398	15.58	36.11	26.71	....	...	8.11	31	....	700	11.25	35.48	27.12	30.36	1.231	1.158	112
	498	14.26	35.91	26.85	....	...	8.11	51	....	1000	7.75	35.22	27.50	32.18	1.53	1.44	076
h	697	11.30	35.48	27.11	....	...	8.01	103	....	1500	5.45	35.18	27.78	34.85	1.87	1.76	051
9.8	1001	7.76	35.22	27.50	....	...	7.92	111	....	2000	4.00	35.02	27.83	37.28	2.14	2.01	047
23°	1513	5.39	35.18	27.80	....	...	7.92	88	....	2500	3.10	34.91	27.83	39.63	2.38	2.24	047
	2029	3.90	35.01	27.83	....	...	7.92	118	....	3000	2.90	34.90	27.84	41.96	2.64	2.48	047
	2550	3.06	34.91	27.83	....	...	7.91	114	....	3500	2.70	34.89	27.84	44.25	2.89	2.72	0.00049
	3080	2.85	34.90	27.84	....	...	7.90	123	....								
	3615	2.66	34.89	27.85	....	...	7.91	125	....								
Station 19: August 20, 1928; 24°00' N, 39°36' W; depth bottom, 5392 m; weather, bcq; sea, M; wind, ESE 1-2; good conditions																	
	0	26.63	36.99	24.35	....	...	8.34	5	....	0	26.63	36.99	24.35	24.35	0.0000	0.0000	0.00359
	5	26.71	36.92	24.28	....	...	8.33	5	....	5	26.71	36.92	24.28	24.30	0.0191	0.0182	366
	14	26.70	36.93	24.28	....	...	8.33	5	....	25	26.70	36.95	24.30	24.41	0.0960	0.0913	365
	24	26.69	36.95	24.30	....	...	8.28	5	....	50	25.20	37.15	24.92	25.15	0.1843	0.1750	305
h	48	25.31	37.15	24.89	....	...	8.27	5	....	75	22.90	37.07	25.55	25.89	0.2572	0.2441	247
8.8	72	23.00	37.07	25.52	....	...	8.26	5	....	100	22.35	37.05	25.69	26.14	0.320	0.304	234
26°	95	22.42	37.05	25.67	....	...	8.25	5	....	150	21.05	36.93	25.97	26.65	0.438	0.414	209
	185[a]	20.10	36.82	26.14	....	...	8.20	7	....	200	19.70	36.77	26.21	27.10	0.544	0.514	188
	291	16.98	36.26	26.50	....	...	8.15	17	....	250	18.20	36.50	26.39	27.53	0.639	0.604	172
	389	15.47	36.08	26.71	....	...	8.12	24	....	300	16.80	36.24	26.53	27.90	0.727	0.687	160
	488	13.81	35.87	26.91	....	...	8.05	38	....	400	15.25	36.05	26.74	28.56	0.888	0.839	143
	688	10.57	35.43	27.20	....	...	7.93	95	....	500	13.60	35.84	26.94	29.23	1.033	0.973	124
										700	10.25	35.39	27.23	30.49	1.273	1.197	100
	697	10.25	35.37	27.22	....	...	7.93	95	....	1000	6.95	35.09	27.52	32.22	1.55	1.46	073
	1006	6.92	35.09	27.52	....	...	7.88	121	....	1500	4.65	34.99	27.73	34.83	1.88	1.78	054
	1512	4.64	34.99	27.73	....	...	7.88	111	....	2000	3.70	34.94	27.79	37.25	2.16	2.05	050
h	2023	3.67	34.94	27.79	....	...	7.88	111	....	2500	3.10	34.93	27.84	39.64	2.41	2.28	046
10.6	2538	3.08	34.93	27.85	....	...	7.88	111	....	3000	2.80	34.88	27.82	41.95	2.66	2.52	049
36°	3053	2.78	34.88	27.83	....	...	7.88	111	....	3500	2.60	34.87	27.84	44.26	2.92	2.77	048
	3568	2.58	34.87	27.84	....	...	7.88	111	....	4000	2.60	34.87	27.84	46.52	3.19	3.01	050
	4091	2.58	34.87	27.84	....	...	7.88	107	....	4500	2.50	34.84	27.82	48.76	3.47	3.27	055
	4616	2.47	34.80	27.79	....	...	7.88	107	....	5000	2.45	34.82	27.81	50.98	3.75	3.55	0.00058
	5148	2.44	34.83	27.82	....	...	7.88	107	....								
Station 20: August 22, 1928; 19°13' N, 38°28' W; depth bottom, 5626 m; weather, bcq; sea, MR; wind, ENE 4; fair conditions; considerable drift																	
	0	26.05	36.55	24.21	....	...	8.37	5	....	0	26.05	36.55	24.21	24.21	0.0000	0.0000	0.00372
h	6	26.05	36.52	24.18	....	...	8.34	5	....	5	26.05	36.52	24.18	24.20	0.0197	0.0187	375
11.6	17	26.02	36.51	24.19	....	...	8.32	4	....	25	25.90	36.54	24.25	24.36	0.0981	0.0931	369
40°	27	25.87	36.55	24.27	....	...	8.34	5	....	50	25.75	36.60	24.34	24.57	0.1943	0.1843	361
	40	25.99	36.61	24.27	....	...	8.32	4	....	75	23.70	36.58	24.94	25.28	0.2820	0.2677	305
	51	25.72	36.60	24.34	....	...	8.26	3	....	100	22.65	36.70	25.34	25.79	0.357	0.339	0.00368

[a] Water bottle not locked.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

	Observed values									Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 20--Continued																	
11.6 h	78	23.57	36.58	24.98	....	...	8.23	5	....	150	21.30	36.81	25.81	26.49	0.487	0.462	0.00224
40°	105	22.56	36.73	25.38	....	...	8.19	5	....	200	18.60	36.56	26.33	27.23	0.594	0.563	177
										250	16.40	36.17	26.57	27.71	0.682	0.645	155
	162	20.89[a]	36.81	25.92	....	...	....	...	....	300	15.25	36.02	26.72	28.09	0.761	0.720	142
	219	17.42	36.33	26.45	....	...	8.10	48	....	400	13.70	35.79	26.87	28.70	0.905	0.856	129
h	316	15.21	36.02	26.72	....	...	8.00	72	....	500	12.05	35.60	27.06	29.37	1.036	0.977	113
9.5	333	14.47	35.89	27.79	....	...	8.01	74	....	700	8.20	35.04	27.29	30.57	1.254	1.183	093
35°	530	11.62	35.54	27.10	....	...	7.94	100	....	1000	5.75	34.85	27.48	32.20	1.52	1.44	075
	761	7.30	34.92	27.34	....	...	7.81	154	....	1500	4.50	34.92	27.69	34.79	1.87	1.77	057
	920	6.04	34.82	27.43	....	...	7.80	154	....	2000	3.70	34.93	27.78	37.24	2.16	2.05	051
	1086	5.49	34.91	27.56	....	...	7.81	147	....	2500	3.20	34.93	27.83	39.63	2.42	2.29	0.00048
h																	
9.5	1697	4.14	34.91	27.72	....	...	7.84	134	....								
40°	2324	3.35	34.95	27.84	....	...	7.87	126	....								
Station 21: August 24, 1928; 15°50' N, 37°56' W; depth bottom, 4977 m; weather, b; sea, S; wind, calm; good conditions																	
	0	26.57	36.28	23.84	....	...	8.32	4	....	0	26.57	36.28	23.84	23.84	0.0000	0.0000	0.00407
	5	26.46	36.28	23.87	....	...	8.28	4	....	5	26.46	36.28	23.87	23.89	0.0214	0.0203	405
	15	26.13	.....	.....	....	...	8.28	4	....	25	25.98	36.26	24.01	24.12	0.1053	0.1000	392
	25	25.98	36.26	24.00	....	...	8.26	4	....	50	24.44	36.24	24.47	24.70	0.2028	0.1927	349
h	38	25.84	.....	.....	....	...	8.26	4	....	75	22.38	36.48	25.25	25.59	0.2851	0.2708	275
11.6	50[b]	24.44	36.24	24.47	....	...	8.25	4	....	100	21.00	36.75	25.84	26.29	0.350	0.332	220
10°	75	22.38	36.48	25.25	....	...	8.25	5	....	150	16.10	36.32	26.76	27.45	0.444	0.421	134
	102[b]	20.93	36.75	25.86	....	...	8.20	7	....	200	13.70	35.70	26.81	27.73	0.514	0.487	130
	202[b]	13.66	35.69	26.81	....	...	7.90	121	....	250	12.40	35.52	26.93	28.09	0.580	0.549	119
	303	11.39	35.36	27.00	....	...	7.83	139	....	300	11.40	35.37	27.01	28.40	0.641	0.608	114
	401	9.78	35.12	27.10	....	...	7.79	139	....	400	9.80	35.12	27.10	28.97	0.757	0.719	107
	503	8.65	34.95	27.15	....	...	7.77	142	....	500	8.55	34.94	27.16	29.50	0.867	0.823	101
										700	6.50	34.76	27.32	30.62	1.067	1.011	087
	508	8.34	34.93	27.19	....	...	7.74	146	....	1000	5.45	34.85	27.52	32.25	1.32	1.25	070
	714	6.39	34.76	27.33	....	...	7.73	163	....	1500	4.35	34.94	27.72	34.83	1.65	1.56	053
h	1020	5.41	34.86	27.54	....	...	7.79	146	....	2000	3.45	34.94	27.82	37.29	1.92	1.81	045
9.8	1534	4.27	34.94	27.73	....	...	7.85	117	....	2500	3.05	34.94	27.86	39.67	2.15	2.03	044
15°	2053	3.42	34.94	27.82	....	...	7.87	111	....	3000	2.65	34.93	27.88	42.02	2.38	2.25	042
	2571	2.99	34.94	27.86	....	...	7.88	111	....	3500	2.55	34.90	27.86	44.29	2.61	2.47	047
	3085	2.61	34.83	27.80	....	...	7.89	113	....	4000	2.50	34.88	27.85	46.53	2.86	2.71	0.00048
	3577	2.54	34.89	27.86	....	...	7.87	109	....								
	4126	2.45	34.87	27.85	....	...	7.87	111	....								
Station 22: August 27, 1928; 13°25' N, 38°00' W; depth bottom, 5980 m; weather, ocq; sea, S; wind, S 0-1; good conditions; big squall passed ahead																	
h	0	26.70	35.97	23.57	....	...	8.26	8	....	0	26.70	35.97	23.57	23.57	0.0000	0.0000	0.00433
10.1	5	26.68	35.94	23.55	....	...	8.26	4	....	5	26.68	35.94	23.55	23.57	0.0229	0.0217	435
4°	15	26.50	36.15	23.76	....	...	8.25	4	....	25	26.27	36.19	23.86	23.97	0.1115	0.1060	407
	25	26.27	36.19	23.86	....	...	8.23	8	....	50	24.50	36.18	24.40	24.63	0.2117	0.2012	0.00355

[a] Mean of 17.31 and 17.54. [b] Water bottles not locked.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 22--Continued																	
	38	25.59	36.14	24.04	....	...	8.23	...	....	75	22.00	36.45	25.34	25.68	0.2938	0.2789	0.00266
h	51	24.44	36.18	24.42	....	...	8.21	9	....	100	17.50	36.11	26.26	26.71	0.353	0.334	180
10.1	76	21.80	36.45	25.40	....	...	8.21	13	....	150	13.80	35.61	26.72	27.41	0.436	0.413	137
4°	100[a]	17.50	.....	.....	....	...	....	...	....	200	12.05	35.39	26.90	27.83	0.506	0.479	121
	102	17.34	36.10	26.29	....	...	7.99	123	....	250	11.20	35.24	26.94	28.10	0.568	0.538	117
	203	12.05	35.40	26.91	....	...	7.87	197	....	300	10.55	35.14	26.98	28.38	0.630	0.596	116
										400	9.60	35.01	27.05	28.92	0.749	0.710	111
	203	11.93	35.38	26.92	....	...	7.86	182	....	500	8.55	34.93	27.15	29.49	0.863	0.817	102
h	306	10.49	35.13	26.99	....	...	7.83	222	....	700	6.65	34.73	27.27	30.57	1.069	1.012	093
9.2	407	9.56	35.00	27.04	....	...	7.67	253	....	1000	5.45	34.77	27.46	32.10	1.34	1.27	076
13°	501	8.54	34.93	27.16	....	...	7.73	265	....	1500	4.25	34.93	27.72	34.83	1.68	1.59	053
	716	6.57	34.72	27.28	....	...	7.75	279	....	2000	3.45	34.92	27.80	37.27	1.96	1.85	047
	1022	5.38	34.78	27.48	....	...	7.76	253	....	2500	3.05	34.89	27.82	39.63	2.20	2.08	0.00047
	1534	4.17	34.95	27.75	....	...	7.87	198	....								
	2045	3.39	34.89	27.78	....	...	7.88	166	....								
	2557	2.98	34.89	27.82	....	...	7.90	200	....								
Station 23: August 29, 1928; 10°50'N, 37°24' W; depth bottom, 4787 m; weather, bcu; sea, S; wind, 0; good conditions																	
	0	27.18	35.90	23.36	....	...	8.25	4	....	0	27.18	35.90	23.36	23.36	0.0000	0.0000	0.00454
	10[b]	27.11	35.91	23.38	....	...	8.28	3	....	5	27.15	35.91	23.37	23.39	0.0238	0.0227	453
	15[b]	27.16	.....	.....	....	...	8.28	4	....	25	27.00	36.02	23.51	23.62	0.1177	0.1120	440
h	24	26.99	36.02	23.51	....	...	8.27	4	....	50	20.90	36.04	25.33	25.56	0.2108	0.2001	265
11.3	36	22.90	.....	.....	....	...	8.21	9	....	75	18.00	36.23	26.23	26.57	0.2700	0.2561	182
15°	49	20.99	36.04	25.30	....	...	8.14	13	....	100	16.55	36.00	26.40	26.86	0.316	0.300	167
	73	18.05	36.23	26.22	....	...	8.05	68	....	150	14.70	35.71	26.60	27.29	0.399	0.378	149
	97[b]	.....[c]	36.02	.....	....	...	8.18	...	....	200	13.20	35.43	26.70	27.62	0.476	0.451	140
	194	13.43	35.46	26.68	....	...	7.90	121	....	250	10.70	35.08	26.91	28.08	0.545	0.516	120
	292	9.74	34.94	26.96	....	...	7.83	130	....	300	9.60	34.92	26.98	28.38	0.607	0.575	116
	386	8.81	34.81	27.02	....	...	7.78	146	....	400	8.70	34.80	27.03	28.90	0.727	0.690	112
	486	8.12	34.78	27.10	....	...	7.75	160	....	500	8.00	34.78	27.12	29.47	0.843	0.798	104
	681	6.26	34.66	27.27	....	...	7.74	172	....	700	6.10	34.66	27.29	30.60	1.048	0.991	090
										1000	5.05	34.72	27.47	32.21	1.31	1.24	074
	715	5.99	34.67	27.32	....	...	7.74	166	....	1500	4.20	34.91	27.72	34.83	1.65	1.56	053
	1021	5.02	34.73	27.48	....	...	7.80	153	....	2000	3.50	34.93	27.80	37.27	1.92	1.82	047
h	1531	.....[c]	34.92	.....	....	...	7.87	106	....	2500	3.05	34.90	27.82	39.63	2.17	2.04	047
9.7	2042	3.42	34.93	27.81	....	...	7.93	99	....	3000	2.75	34.88	27.83	41.96	2.42	2.29	048
0°	2550	3.04	34.90	27.83	....	...	7.89	94	....	3500	2.55	34.88	27.85	44.28	2.67	2.53	047
	3059	2.70	34.88	27.83	....	...	7.89	99	....	4000	2.50	34.84	27.82	46.51	2.93	2.77	0.00052
	3567	.....[c]	34.88	.....	....	...	7.88	111	....								
	4076	2.43	34.81	27.80	....	...	7.91	115	....								

[a] Depth by pressure tube, 107 meters. [b] Water bottles not properly locked. [c] Thermometers not functioning.

Table 2--Physical and chemical data and results of dynamic computations for _Carnegie_ deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 24: August 31, 1928; 8°15' N; 36°10' W; depth bottom, 3836 m; weather, bc; sea, ML; wind, W by N 3; good conditions; some pitching																	
	0	27.18	35.22	22.84	....	...	8.32	4	....	0	27.18	35.22	22.84	22.84	0.0000	0.0000	0.00503
h	5	27.16	35.23	22.86	....	...	8.30	4	....	5	27.16	35.23	22.86	22.88	0.0264	0.0251	501
10.6	15	27.22	.....	.....	....	...	8.28	4	....	25	27.22	35.54	23.07	23.18	0.1298	0.1234	482
25°	25	27.22	35.54	23.07	....	...	8.28	4	....	50	23.12	36.00	24.67	24.90	0.2366	0.2249	330
	37	26.82	.....	.....	....	...	8.26	4	....	75	18.55	35.85	25.80	26.14	0.3095	0.2942	223
	50	23.12	36.00	24.67	....	...	8.14	8	....	100	15.55	35.64	26.36	26.82	0.361	0.343	171
	77	18.49	35.85	25.82	....	...	8.04	72	....	150	11.20	35.10	26.83	27.53	0.439	0.417	125
	102	15.55	35.61	26.34	....	...	7.96	99	....	200	9.85	34.93	26.94	27.87	0.504	0.478	116
	155	11.01	35.09	26.86	....	...	7.87	133	....	250	9.45	34.86	26.95	28.12	0.566	0.535	116
										300	9.00	34.79	26.97	28.38	0.627	0.594	116
	208	9.76	34.92	26.95	....	...	7.83	137	....	400	8.00	34.71	27.07	28.95	0.745	0.706	108
	272	9.29	34.83	26.96	....	...	7.82	141	....	500	7.10	34.67	27.17	29.53	0.855	0.809	098
	364	8.30	34.73	27.03	....	...	7.75	145	....	700	5.75	34.59	27.28	30.60	1.054	0.998	091
h	454	7.56	34.70	27.12	....	...	7.73	150	....	1000	4.85	34.68	27.46	32.20	1.31	1.25	075
9.4	548	6.72	34.63	27.18	....	...	7.74	153	....	1500	4.25	34.93	27.72	34.83	1.66	1.57	053
25°	739	5.61	34.59	27.30	....	...	7.73	169	....	2000	3.50	34.91	27.79	37.26	1.93	1.83	049
	1028	4.81	34.70	27.48	....	...	7.78	154	....	2500	3.00	34.90	27.83	39.64	2.18	2.06	0.00046
	1513	4.24	34.93	27.73	....	...	7.87	117	....								
	2008	3.47	34.90	27.78	....	...	7.88	107	....								
	2516	2.98	34.90	27.83	....	...	7.89	107	....								
Station 25: September 3, 1928; 11°02' N, 37°06' W; depth bottom, 4851 m; weather, bc; sea, SL; wind, W 3; good conditions; heavy swell from southwest																	
	0	27.47	35.56	23.01	....	...	8.31	5	....	0	27.47	35.56	23.01	23.01	0.0000	0.0000	0.00487
	5	27.45	35.55	23.01	....	...	8.30	5	....	5	27.45	35.55	23.01	23.03	0.0256	0.0244	487
	15	27.34	.....	.....	....	...	8.30	4	....	25	26.64	35.93	23.55	23.66	0.1227	0.1167	436
h	25	26.64	35.93	23.55	....	...	8.30	4	....	50	21.49	36.02	25.15	25.38	0.2175	0.2064	282
10.4	38	22.84	.....	.....	....	...	8.22	8	....	75	17.65	35.82	26.00	26.34	0.2819	0.2673	204
12°	50	21.49	36.02	25.15	....	...	8.22	12	....	100	14.60	35.70	26.62	27.08	0.328	0.311	146
	74	17.68	35.82	25.99	....	...	8.01	103	....	150	11.35	35.36	27.01	27.71	0.395	0.374	109
	100	14.60	35.70	26.62	....	...	7.93	121	....	200	9.95	34.96	26.95	27.88	0.455	0.431	116
	203	9.91	34.95	26.95	....	...	7.81	151	....	250	9.30	34.87	27.00	28.17	0.515	0.488	111
	304	8.73	34.83	27.05	....	...	7.79	163	....	300	8.80	34.83	27.03	28.43	0.574	0.543	110
										400	7.90	34.75	27.11	28.99	0.687	0.651	104
	328	.....[a]	34.82	.....	....	...	7.77	181	....	500	7.15	34.70	27.18	29.54	0.795	0.751	097
	436	7.60	34.72	27.13	....	...	7.75	209	....	700	6.80	34.63	27.17	30.47	1.005	0.950	102
h	547	6.87	34.69	27.21	....	...	7.75	209	....	1000	5.00	34.71	27.47	32.21	1.28	1.22	074
9.4	764	5.47	34.63	27.35	....	...	7.74	220	....	1500	4.25	34.93	27.72	34.83	1.62	1.54	053
10°	928	5.12	34.67	27.42	....	...	7.75	201	....	2000	3.50	34.93	27.80	37.27	1.90	1.80	048
	1091	4.95	34.78	27.53	....	...	7.80	194	....	2500	3.10	34.90	27.82	39.62	2.15	2.03	0.00048
	1638	3.95	34.94	27.77	....	...	7.88	154	....								
	2186	3.32	34.92	27.81	....	...	7.92	139	....								
	2735	2.96	34.89	27.83	....	...	7.92	131	....								

[a] Thermometer not functioning.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 26: September 5, 1928; 11°33' N, 40°43' W; depth bottom, 4492 m; weather, bc; sea, CR; wind, NE 4; very bad conditions; heavy tide rips and vessel drifting badly in cross-currents; apparently unusual currents at various depths																	
	0	27.61	36.03	23.32	....	...	8.30	5	....	0	27.61	36.03	23.32	23.32	0.0000	0.0000	0.00457
	6	27.60	36.03	23.32	....	...	8.30	...	....	5	27.60	36.03	23.32	23.34	0.0241	0.0229	457
	17	27.40	.....	.....	....	...	8.30	5	....	25	27.70	36.07	23.32	23.43	0.1203	0.1144	458
h	29	27.87	36.08	23.26	....	...	8.30	...	....	50	24.10	36.14	24.49	24.72	0.2263	0.2150	347
10.1	41	27.19	.....	.....	....	...	8.29	5	....	75	20.00	36.18	25.68	26.02	0.3029	0.2877	234
41°	50	24.10	36.14	24.49	....	...	8.21	...	....	100	14.90	35.56	26.44	26.90	0.355	0.337	163
	70	21.71	36.18	25.20	....	...	8.21	...	....	150	11.40	35.16	26.84	27.54	0.431	0.409	125
	91	18.40	36.08	26.01	....	...	8.11	40	....	200	10.35	35.02	26.93	27.86	0.496	0.470	117
	165	11.00	35.09	26.86	....	...	7.83	134	....	250	9.65	34.93	26.97	28.14	0.557	0.528	115
	234	9.64	34.94	26.98	....	...	7.78	134	....	300	9.00	34.85	27.02	28.42	0.617	0.584	111
										400	7.95	34.74	27.10	28.98	0.731	0.693	105
	82a)	15.76	35.73	26.38	....	...	7.95	...	....	500	7.15	34.66	27.15	29.51	0.841	0.795	100
	220	10.38	35.01	26.91	....	...	7.80	...	....	700	5.80	34.60	27.28	30.59	1.043	0.986	0.00091
	373	8.21	34.76	27.08	....	...	7.77	...	....								
h	465	7.38	34.71	27.16	....	...	7.76	...	....								
9.4	490	7.27	34.66	27.14	....	...	7.75	161	....								
61°	520	7.06	34.65	27.15	....	...	7.76	...	....								
	551	6.81	34.65	27.19	....	...	7.76	...	....								
	585	6.57	34.61	27.19	....	...	7.76	...	....								
	621	6.44	34.60	27.20	....	...	7.75	149	....								
	750	5.57	34.61	27.32	....	...	7.75	143	....								
Station 27: September 7, 1928; 11°20' N, 44°12' W; depth bottom, 2571 m; weather, bc; sea, SL; wind, NNE 0-1; good conditions though still some evidence of current; vessel practically becalmed																	
	0	27.53	36.26	23.52	....	...	8.31	4	....	0	27.53	36.26	23.52	23.52	0.0000	0.0000	0.00438
	5	27.53	36.22	23.49	....	...	8.31	4	....	5	27.53	36,22	23.49	23.51	0.0231	0.0220	441
h	15	27.41	.....	.....	....	...	8.30	4	....	25	27.39	36.22	23.53	23.64	0.1156	0.1099	438
10.2	25	27.39	36.22	23.53	....	...	8.30	4	....	50	26.04	36.25	23.98	24.21	0.2253	0.2140	395
30°	37	27.02	.....	.....	....	...	8.30	4	....	75	22.09	36.15	25.08	25.42	0.3158	0.2999	291
	50	26.04	36.25	23.98	....	...	8.30	4	....	100	17.75	36.02	26.13	26.58	0.379	0.360	192
	75	22.09	36.15	25.08	....	...	8.20	8	....	150	13.00	35.50	26.80	27.49	0.465	0.440	129
	99	18.08	36.03	26.06	....	...	8.09	46	....	200	11.45	35.15	26.83	27.76	0.533	0.505	128
	199	11.17	35.12	26.85	....	...	7.84	100	....	250	10.70	35.02	26.87	28.04	0.599	0.568	124
										300	10.05	34.94	26.92	28.32	0.664	0.629	121
	197	11.63	35.18	26.82	....	...	7.84	106	....	400	8.90	34.84	27.03	28.90	0.787	0.746	112
	289	10.23	34.96	26.90	....	...	7.82	115	....	500	8.05	34.82	27.14	29.49	0.902	0.853	102
h	381	9.08	34.85	27.00	....	...	7.80	118	....	700	6.00	34.62	27.28	30.59	1.106	1.046	091
9.0	475	8.23	34.83	27.12	....	...	7.74	127	....	1000	5.00	34.70	27.46	32.20	1.37	1.30	075
38°	669	6.22	34.64	27.26	....	...	7.73	142	....	1500	4.25	34.95	27.74	34.85	1.71	1.62	051
	960	5.11	34.67	27.42	....	...	7.76	131	....	2000	3.35	34.92	27.81	37.29	1.97	1.86	046
	1593	4.02	34.96	27.78	....	...	7.89	88	....	2500	2.95	34.88	27.82	39.63	2.21	2.09	0.00047
	2071	3.29	34.91	27.81	....	...	7.92	98	....								
	2571	2.88	34.87	27.82	....	...	7.92	105	....								

a) Water bottle not locked.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep-sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 28: September 11, 1928; 13°10' N, 49°36' W; depth bottom, 4925 m; weather, bc; sea, CL; wind, SSW 4; fair conditions																	
	0	27.62	36.26	23.49	....	...	8.29	4	....	0	27.62	36.26	23.49	23.49	0.0000	0.0000	0.00441
	5	27.62	36.25	23.48	....	...	8.31	4	....	5	27.62	36.25	23.48	23.50	0.0232	0.0221	442
	25	27.57	36.24	23.49	....	...	8.30	4	....	25	27.57	36.24	23.49	23.60	0.1162	0.1105	442
h	36	27.56	.....	.....	....	...	8.28	4	....	50	26.70	36.32	23.83	24.06	0.2283	0.2169	409
9.8	48	26.79	36.31	23.79	....	...	8.26	4	....	75	24.70	36.48	24.57	24.91	0.3270	0.3107	341
10°	60	26.00	.....	.....	....	...	8.23	4	....	100	22.80	36.63	25.24	25.69	0.408	0.388	278
	72	24.88	36.45	24.49	....	...	8.25	4	....	150	17.70	36.21	26.29	26.97	0.529	0.502	178
	94	23.34	36.63	25.09	....	...	8.22	7	....	200	13.85	35.72	26.79	27.71	0.612	0.580	133
	142	18.63	.....	.....	....	...	8.12	17	....	250	12.30	35.47	26.92	28.08	0.678	0.643	120
	189	14.46	35.82	26.74	....	...	7.96	50	....	300	11.15	35.28	26.98	28.37	0.741	0.702	116
										400	9.40	35.02	27.09	28.96	0.858	0.814	107
	204	13.86	35.69	26.77	....	...	7.93	50	....	500	8.00	34.83	27.16	29.51	0.969	0.918	100
h	307	11.08	35.27	26.99	....	...	7.86	102	....	700	5.95	34.68	27.33	30.64	1.166	1.104	086
9.0	406	9.33	35.01	27.09	....	...	7.81	126	....	1000	5.25	34.75	27.46	32.20	1.42	1.35	076
11°	509	7.91	34.82	27.17	....	...	7.77	143	....	1500	4.35	34.97	27.74	34.85	1.76	1.67	051
	707	5.92	34.68	27.33	....	...	7.73	155	....	2000	3.45	34.95	27.82	37.29	2.02	1.92	046
	1011	5.24	34.76	27.47	....	...	7.74	143	....	2500	3.00	34.92	27.85	39.66	2.26	2.14	0.00044
	1515	4.33	34.97	27.74	....	...	7.84	98	....								
	2015	3.44	34.95	27.83	....	...	7.88	88	....								
	2516	2.97	34.92	27.85	....	...	7.89	88	....								
Station 29: September 13, 1928; 13°16' N, 52°13' W; depth bottom, 5068 m; weather, bc; sea, MC; wind, NE 4; fair conditions; considerable wind and swell																	
	0	27.56	36.21	23.47	....	...	8.31	3	....	0	27.56	36.21	23.47	23.47	0.0000	0.0000	0.00443
	5	27.55	36.19	23.46	....	...	8.31	3	....	5	27.55	36.19	23.46	23.48	0.0233	0.0222	443
	26	27.51	36.22	23.49	....	...	8.30	3	....	25	27.50	36.22	23.50	23.61	0.1164	0.1106	441
h	51	27.11	36.22	23.62	....	...	8.29	3	....	50	27.15	36.22	23.61	23.84	0.2311	0.2195	430
10.3	64	26.08	.....	.....	....	...	8.26	3	....	75	25.70	36.20	24.05	24.39	0.3391	0.3222	391
30°	76	25.67	36.20	24.06	....	...	8.26	3	....	100	23.10	36.59	25.13	25.58	0.428	0.407	288
	100	23.10	36.59	25.13	....	...	8.21	8	....	150	17.90	36.33	26.33	27.01	0.550	0.522	174
	151	17.84	36.33	26.35	....	...	8.06	38	....	200	15.90	36.15	26.67	27.58	0.636	0.602	144
	203	15.79	36.13	26.68	....	...	8.05	59	....	250	13.45	35.80	26.94	28.09	0.705	0.667	118
	311	10.84	35.26	27.02	....	...	7.87	122	....	300	11.50	35.37	26.99	28.38	0.767	0.726	115
	415	9.03	34.96	27.10	....	...	7.81	158	....	400	9.35	35.01	27.09	28.96	0.884	0.837	107
										500	7.90	34.79	27.14	29.49	0.996	0.942	102
	328	10.89	35.27	27.03	....	...	7.84	130	....	700	6.15	34.65	27.28	30.59	1.200	1.135	091
	420	9.28	34.97	27.07	....	...	7.80	157	....	1000	5.05	34.68	27.44	32.19	1.46	1.39	076
	593	6.81	34.66	27.20	....	...	7.86	184	....	1500	4.50	34.97	27.73	34.84	1.81	1.71	053
h	724	6.00	34.65	27.30	....	...	7.75	197	....	2000	3.50	34.95	27.82	37.29	2.07	1.97	046
9.2	857	5.34	34.63	27.36	....	...	7.75	197	....	2500	3.00	34.91	27.84	39.65	2.31	2.19	045
45°	1319	4.76	34.91	27.65	....	...	7.82	139	....	3000	2.75	34.90	27.84	41.98	2.55	2.42	0.00047
	1801	3.80	34.97	27.81	....	...	7.90	106	....								
	2290	3.20	34.93	27.83	....	...	7.90	101	....								
	2824	2.81	34.89	27.83	....	...	7.90	114	....								
	3220	2.64	34.91	27.86	....	...	7.91	106	....								

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 30: September 15, 1928; 12°54' N, 56°15' W; depth bottom, 4703 m; weather, bc; sea, MC; wind, ESE 3; considerable drift; cup above upper valve of lowest water-bottle full of bottom ooze																	
	0	28.05	36.07	23.20	....	...	8.30	2	....	0	28.05	36.07	23.20	23.20	0.0000	0.0000	0.00469
	4	28.04	36.05	23.19	....	...	8.30	2	....	5	28.05	36.05	23.19	23.21	0.0247	0.0235	469
	22	27.90	36.06	23.24	....	...	8.30	3	....	25	27.90	36.06	23.24	23.35	0.1231	0.1170	466
h	42	27.88	36.08	23.26	....	...	8.30	3	....	50	27.75	36.09	23.31	23.54	0.2447	0.2326	459
11.7	63[a]	26.99	36.11	23.58	....	...	8.29	3	....	75	26.30	36.23	23.88	24.22	0.3586	0.3410	407
44°	82	25.54	36.40	24.25	....	...	8.28	3	....	100	24.10	36.35	24.65	25.10	0.456	0.433	334
	165	16.29	35.90	26.39	....	...	7.96	43	....	150	17.66	36.03	26.16	26.84	0.594	0.564	191
	250	12.30	35.32	26.80	....	...	7.85	87	....	200	14.15	35.61	26.64	27.56	0.684	0.649	146
	331	10.43	35.11	26.98	....	...	7.80	94	....	250	12.30	35.32	26.80	27.96	0.757	0.718	132
	418	9.01	34.91	27.07	....	...	7.77	121	....	300	11.05	35.18	26.92	28.31	0.825	0.782	121
										400	9.30	34.93	27.03	28.90	0.948	0.899	112
h	519	8.22	34.87	27.16	....	...	7.77	155	....	500	8.30	34.88	27.15	29.50	1.062	1.005	101
10.2	951	5.12	34.65	27.41	....	...	7.75	161	....	700	6.50	34.71	27.28	30.59	1.265	1.198	092
46°	1376	4.75	34.91	27.65	....	...	7.83	114	....	1000	5.05	34.68	27.44	32.18	1.53	1.45	076
	1811	3.70	34.97	27.82	....	...	7.89	88	....	1500	4.55	34.94	27.70	34.81	1.88	1.79	056
	2171	3.28	34.94	27.83	....	...	7.89	88	....	2000	3.45	34.96	27.83	37.30	2.16	2.04	044
	2398	3.13	34.89	27.81	....	...	7.89	88	....	2500	3.05	34.91	27.83	39.64	2.39	2.26	047
	2745	2.91	34.93	27.86	....	...	7.89	94	....	3000	2.85	34.90	27.84	41.97	2.64	2.50	0.00047
h	531	8.14	34.87	27.17	....	...	7.81	145	....								
9.5	723	6.30	34.69	27.29	....	...	7.72	151	....								
36°	4703	2.17	.....	.....	....	...	7.85	94	....								
Station 31: October 3, 1928; 14°46' N, 63°26' W; depth bottom, 1635 m; weather, bc; sea, S; wind, E; good conditions																	
	0	28.54	34.40	21.79	....	...	8.27	2	....	0	28.54	34.40	21.79	21.79	0.0000	0.0000	0.00604
	6	28.54	34.38	21.77	....	...	8.26	2	....	5	28.54	34.38	21.77	21.79	0.0317	0.0303	606
h	27	28.65	34.67	21.95	....	...	8.26	2	....	25	28.65	34.65	21.94	22.05	0.1573	0.1499	590
9.9	40	28.27	.....	.....	....	...	8.25	2	....	50	28.20	35.36	22.62	22.85	0.3039	0.2893	525
8°	53	28.13	35.53	22.77	....	...	8.23	2	....	75	25.90	36.12	23.93	24.27	0.4258	0.4052	402
	66	27.11	.....	.....	....	...	8.22	2	....	100	23.45	36.49	24.95	25.40	0.519	0.493	305
	78	25.38	36.22	24.16	....	...	8.23	3	....	150	19.85	36.38	25.87	26.55	0.657	0.624	218
	103	22.56	36.51	25.22	....	...	8.19	28	....	200	16.05	36.12	26.62	27.53	0.755	0.716	149
										250	13.25	35.66	26.87	28.03	0.827	0.784	125
	100	24.30	36.48	24.69	....	...	8.17	38	....	300	11.50	35.30	26.93	28.32	0.892	0.846	120
	195	16.48	36.15	26.54	....	...	8.02	58	....	400	9.30	34.98	27.07	28.94	1.013	0.961	109
h	283	12.11	35.42	26.91	....	...	7.92	126	....	500	8.00	34.84	27.17	29.52	1.124	1.065	99
9.2	371	9.76	35.02	27.02	....	...	7.86	159	....	700	6.05	34.68	27.31	30.62	1.322	1.252	88
25°	457	8.58	34.92	27.14	....	...	7.82	186	....	1000	4.85	34.86	27.60	32.35	1.56	1.48	61
	625	6.64	34.69	27.24	....	...	7.79	216	....	1500	4.10	34.95	27.76	34.88	1.85	1.76	0.00049
	878	5.26	34.80	27.50	....	...	7.73	222	....								
	1327	4.26	34.95	27.74	....	...	7.80	186	....								
	1477	4.12	34.94	27.75	....	...	7.83	186	....								

[a] Water bottle not locked.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

L.M.T. and wire angle	Observed values: Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	Interpolated values: A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Computed values: Density (σ_{tP})	Anomalies: Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 32: October 5, 1928; 15°18' N, 68°11' W; depth bottom, 4566 m; weather, bc; sea, MS; wind, E																	
	0	28.01	35.97	23.14	....	...	8.23	2	....	0	28.01	35.97	23.14	23.14	0.0000	0.0000	0.00474
	5	28.01	35.96	23.13	....	...	8.24	2	....	5	28.01	35.96	23.13	23.15	0.0250	0.0237	474
	23	27.96	36.01	23.19	....	...	8.24	2	....	25	27.95	36.01	23.19	23.30	0.1245	0.1182	471
	47	27.30	35.90	23.32	....	...	8.24	2	....	50	27.20	35.90	23.35	23.58	0.2463	0.2340	455
h	58	26.67	.....	.....	....	...	8.24	2	....	75	24.20	36.27	24.56	24.90	0.3512	0.3337	342
10.2	68	24.93	36.16	24.26	....	...	8.20	4	....	100	22.20	36.37	25.22	25.67	0.433	0.411	279
22°	77	24.11	.....	.....	....	...	8.16	24	....	150	18.50	36.30	26.16	26.84	0.557	0.528	191
	89	23.30	36.38	24.91	....	...	8.15	19	....	200	16.35	36.17	26.59	27.50	0.648	0.615	152
	179	17.16	36.23	26.44	....	...	8.06	64	....	250	14.90	35.91	26.71	27.86	0.725	0.688	141
	268	14.36	35.78	26.73	....	...	7.94	111	....	300	13.25	35.57	26.80	28.18	0.798	0.757	134
	355	11.52	35.34	26.96	....	...	7.83	159	....	400	10.20	35.11	27.02	28.89	0.929	0.881	114
	443	9.31	34.99	27.08	....	...	7.78	202	....	500	8.35	34.90	27.16	29.51	1.042	0.988	100
										700	6.30	34.72	27.32	30.63	1.240	1.176	088
h	357	11.05	35.20	26.94	....	...	7.85	186	....	1000	4.90	34.81	27.56	32.31	1.48	1.41	065
11.5	519	8.05	34.88	27.19	....	...	7.78	257	....	1500	4.10	34.96	27.77	34.89	1.78	1.69	0.00047
33°	772	5.84	34.71	27.36	....	...	7.88	279	....								
	1223	4.37	34.90	27.68	....	...	7.82	209	....								
	1413	4.16	34.95	27.75	....	...	7.83	209	....								
Station 33: October 8, 1928; 13°37' N, 76°22' W; depth bottom, 4039 m; weather, bc; sea, MR; wind, E 4; fairly good conditions; vessel rolling and pitching; lowest water bottle on first series not removed until end of second series; apparently overturned during second lowering																	
	0	28.49	35.63	22.73	....	...	8.23	4	....	0	28.49	35.63	22.73	22.73	0.0000	0.0000	0.00513
	5	28.48	35.58	22.70	....	...	8.23	4	....	5	28.48	35.58	22.70	22.72	0.0271	0.0257	515
h	24	28.46	35.56	22.68	....	...	8.24	4	....	25	28.45	35.56	22.69	22.80	0.1359	0.1290	518
9.8	48	28.25	36.19	23.23	....	...	8.24	4	....	50	28.15	36.20	23.26	23.49	0.2651	0.2518	464
30°	71	25.80	36.43	24.19	....	...	8.25	5	....	75	25.40	36.44	24.33	24.67	0.3740	0.3554	364
	92	23.17	36.49	25.03	....	...	8.18	23	....	100	22.30	36.49	25.28	25.73	0.458	0.435	273
	190	17.77	36.36	26.38	....	...	8.13	40	....	150	19.15	36.44	26.10	26.78	0.582	0.552	196
	275	15.19	35.95	26.68	....	...	8.02	91	....	200	17.50	36.33	26.43	27.33	0.679	0.643	167
										250	15.80	36.10	26.66	27.80	0.762	0.721	146
	288	14.45	35.85	26.76	....	...	8.01	99	....	300	14.20	35.83	26.80	28.17	0.837	0.791	134
h	381	11.82	35.47	27.00	....	...	7.92	127	....	400	11.35	35.39	27.03	28.89	0.968	0.915	113
8.8	477	9.56	35.09	27.12	....	...	7.86	172	....	500	9.10	35.00	27.12	29.46	1.084	1.024	105
31°	661	6.74	34.73	27.26	....	...	7.75	184	....	700	6.40	34.72	27.30	30.60	1.290	1.219	090
	944	5.08	34.87	27.58	....	...	7.83	197	....	1000	4.95	34.90	27.62	32.36	1.53	1.44	059
	1420	4.32	34.96	27.74	....	...	7.88	166	....	1500	4.25	34.96	27.75	34.86	1.82	1.72	050
	2075	.....	34.96	.....	....	...	7.83	158	....	2000	4.10	34.96	27.77	37.22	2.10	1.98	0.00053
Station 34: October 9, 1928; 11°18' N, 78°34' W; depth bottom, 3536 m; weather, cu; sea, MC; wind, E 4; not very good conditions; vessel rolling and pitching; evidence of strong currents																	
	0	28.51	35.87	22.91	....	...	8.28	2	....	0	28.51	35.87	22.91	22.91	0.0000	0.0000	0.00496
	5	28.51	35.80	22.85	....	...	8.28	2	....	5	28.51	35.80	22.85	22.87	0.0263	0.0250	501
h	24	28.32	36.11	23.14	....	...	8.33	2	....	25	28.35	36.12	23.14	23.25	0.1291	0.1226	475
14.7	47	24.98	36.53	24.52	....	...	8.21	3	....	50	24.95	36.53	24.53	24.76	0.2367	0.2248	343
15°	70	24.63	36.55	24.65	....	...	8.21	3	....	75	24.00	36.57	24.85	25.19	0.3232	0.3070	314
	92	21.02	36.65	25.76	....	...	8.16	16	....	100	20.50	36.65	25.90	26.35	0.393	0.373	214
	186	16.37	36.18	26.58	....	...	8.10	66	....	150	17.75	36.44	26.45	27.13	0.493	0.467	163
	281	12.80	35.57	26.89	....	...	7.95	134	....	200	15.65	36.08	26.67	27.58	0.575	0.544	0.00144

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 34--Continued																	
	313	11.42	35.33	26.97	....	...	7.92	122	....	250	13.70	35.70	26.81	27.96	0.647	0.613	0.00131
h	418	9.32	35.06	27.13	....	...	7.85	150	....	300	12.05	35.42	26.93	28.32	0.714	0.676	121
13.5	523	7.85	34.85	27.20	....	...	7.79	177	....	400	9.60	35.10	27.12	28.99	0.833	0.789	104
16°	723	6.19	34.70	27.31	....	...	7.78	184	....	500	8.10	34.89	27.19	29.54	0.940	0.890	097
	1053	4.75	34.92	27.66	....	...	7.84	161	....	700	6.35	34.70	27.29	30.60	1.138	1.076	090
	1582	4.10	34.96	27.77	....	...	7.87	149	....	1000	4.95	34.89	27.62	32.36	1.38	1.30	059
	2287	4.07	34.96	27.77	....	...	7.85	142	....	1500	4.10	34.96	27.77	34.89	1.67	1.57	048
										2000	4.10	34.96	27.77	37.22	1.94	1.83	0.00053
Station 35: October 26, 1928; 6°32' N, 80°04' W; depth bottom, 3583 m; weather, crtl; sea, L; wind, SE 0-1; fair conditions; raining most of time; little wind, heavy swell, strong current																	
	0	27.44	29.70	18.62	....	...	8.31	15	....	0	27.44	29.70	18.62	18.62	0.0000	0.0000	0.00908
	6	27.48	29.81	18.69	....	...	8.30	15	....	5	27.50	29.80	18.68	18.70	0.0474	0.0453	902
	27	24.62	33.55	22.38	....	...	8.28	28	....	25	24.65	33.21	22.11	22.22	0.2022	0.1929	574
h	54	16.30	34.88	25.60	....	...	7.92	138	....	50	16.80	34.75	25.39	25.62	0.3120	0.2971	260
11.8	79	14.99	34.94	25.94	....	...	7.88	174	....	75	15.15	34.94	25.92	26.27	0.3743	0.3561	211
38°	104	14.33	34.91	26.06	....	...	7.88	189	....	100	14.45	34.91	26.04	26.50	0.428	0.407	201
	210	13.25	34.92	26.30	....	...	7.87	194	....	150	13.80	34.92	26.19	26.88	0.531	0.504	187
	319	11.11	34.76	26.59	....	...	7.77	233	....	200	13.35	34.92	26.28	27.20	0.629	0.597	180
	421	..... a)	34.63	.....	....	...	7.71	279	....	250	12.60	34.85	26.37	27.53	0.721	0.684	173
	533	..... a)	34.59	.....	....	...	7.71	204	....	300	11.60	34.78	26.51	27.90	0.810	0.768	161
										400	8.40	34.64	26.95	28.83	0.957	0.909	120
h	453	7.37	34.58	27.06	....	...	7.71	198	....	500	7.10	34.59	27.10	29.46	1.077	1.022	105
10.6	655	6.22	34.58	27.21	....	...	7.73	206	....	700	6.00	34.57	27.24	30.55	1.288	1.221	094
54°	952	4.88	34.54	27.34	....	...	7.74	200	....	1000	4.70	34.54	27.36	32.12	1.57	1.49	084
	1456	3.29	34.57	27.54	....	...	7.74	198	....	1500	3.20	34.58	27.55	34.71	1.96	1.87	066
	1987	2.35	34.63	27.66	....	...	7.80	193	....	2000	2.35	34.63	27.67	37.20	2.28	2.18	056
	2599	2.08	34.63	27.69	....	...	7.76	184	....	2500	2.10	34.63	27.68	39.56	2.56	2.45	057
	3063	2.04	34.62	27.68	....	...	7.80	172	....	3000	2.05	34.63	27.69	41.89	2.85	2.75	0.00058
Station 36: October 30, 1928; 2°54' N, 80°02' W; depth bottom, 4880 m; weather, cor; sea, CL; wind, SSW 4; conditions not very good; rain and squally																	
	0	26.54	31.62	20.34	....	...	8.23	16	....	0	26.54	31.62	20.34	20.34	0.0000	0.0000	0.00742
	4	26.57	31.62	20.33	....	...	8.23	16	....	5	26.55	31.62	20.34	20.36	0.0389	0.0371	742
h	23	26.71	31.73	20.37	....	...	8.25	16	....	25	26.70	31.84	20.46	20.57	0.1937	0.1846	732
9.6	48	18.87	34.44	24.64	....	...	8.03	122	....	50	18.50	34.50	24.78	25.01	0.3317	0.3158	318
14°	71	14.97	34.97	25.97	....	...	7.85	134	....	75	14.90	34.97	25.99	26.34	0.4007	0.3812	205
	93	14.51	34.90	26.02	....	...	7.85	149	....	100	14.45	34.90	26.03	26.49	0.454	0.432	202
	187	13.45	34.93	26.26	....	...	7.82	190	....	150	13.90	34.94	26.18	26.87	0.557	0.529	189
	283	11.91	34.86	26.52	....	...	7.75	201	....	200	13.30	34.92	26.29	27.21	0.655	0.622	179
	374	9.86	34.69	26.75	....	...	7.65	236	....	250	12.55	34.89	26.41	27.57	0.746	0.709	169
										300	11.55	34.83	26.56	27.95	0.832	0.790	157
	358	10.28	34.67	26.66	....	...	7.68	252	....	400	9.70	34.68	26.77	28.64	0.987	0.938	138
h	448	9.30	34.68	26.83	....	...	7.66	248	....	500	8.70	34.62	26.89	29.24	1.127	1.070	126
8.8	624	7.15	34.57	27.08	....	...	7.64	243	....	700	6.45	34.56	27.16	30.47	1.368	1.299	103
22°	899	5.12 b)	34.57	27.34	....	...	7.65	239	....	1000	4.75	34.57	27.38	32.13	1.66	1.58	082
	1296	....	34.57	.....	....	...	7.66	251	....	1500	3.25	34.58	27.55	34.71	2.05	1.95	066
	1800	2.74	34.59	27.60	....	...	7.71	248	....	2000	2.50	34.60	27.63	37.16	2.38	2.27	0.00060
	2314	2.18	34.91	27.91	....	...	7.91	63	....								

a) Thermometer off scale. b) Thermometer not functioning properly.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 37: November 1, 1928; 5°59' N, 82°56' W; depth bottom, 3324 m; weather, cd; sea, M; wind, WSW 2; good conditions																	
	0	27.12	31.68	20.20	....	...	8.28	15	....	0	27.12	31.68	20.20	20.20	0.0000	0.0000	0.00756
	7	27.10	31.70	20.23	....	...	8.21	17	....	5	27.10	31.70	20.23	20.25	0.0396	0.0378	753
	28	24.62	31.69	20.98	....	...	8.21	19	....	25	25.00	31.69	20.87	20.98	0.1913	0.1824	693
h	50	19.82	34.53	24.47	....	...	8.00	121	....	50	19.82	34.53	24.47	24.70	0.3281	0.3125	348
10.3	73	16.11	34.93	25.69	....	...	7.84	158	....	75	16.10	34.93	25.70	26.05	0.4046	0.3851	232
8°	96	15.21	34.93	25.89	....	...	7.82	153	....	100	15.10	34.93	25.91	26.37	0.463	0.440	213
	188	13.05	34.85	26.28	....	...	7.76	166	....	150	13.75	34.88	26.16	26.85	0.569	0.541	190
	279	11.12	34.78	26.60	....	...	7.84	206	....	200	12.85	34.83	26.31	27.23	0.667	0.633	177
	371	9.36	34.65	26.80	....	...	7.62	228	....	250	11.80	34.79	26.48	27.64	0.757	0.718	162
	464	8.37	34.62	26.94	....	...	7.65	252.	....	300	10.65	34.74	26.65	28.05	0.838	0.795	147
										400	8.95	34.67	26.89	28.76	0.982	0.932	125
	522	8.11	34.65	27.00	....	...	7.63	249	....	500	8.20	34.63	26.97	29.32	1.112	1.053	118
h	703	6.22	34.57	27.20	....	...	7.64	263	....	700	6.25	34.57	27.20	30.51	1.341	1.270	099
9.1	979	4.82	34.53	27.34	....	...	7.67	260	....	1000	4.75	34.53	27.35	32.10	1.63	1.55	085
5°	1446	3.42	34.61	27.56	....	...	7.67	260	....	1500	3.25	34.60	27.56	34.72	2.03	1.93	066
	1910	2.49	34.63	27.65	....	...	7.70	255	....	2000	2.35	34.62	27.66	37.19	2.35	2.24	057
	2231	2.22	34.61	27.67	....	...	7.68	252	....	2500	2.10	34.63	27.68	39.56	2.63	2.52	057
	2730	2.05	34.65	27.71	....	...	7.71	252	....	3000	2.05	34.64	27.70	41.91	2.91	2.81	0.00057
	3231	2.10	34.63	27.68	....	...	7.69	252	....								
	3324	2.12	.....	.....	....	...	7.67	...	....								
Station 38: November 3, 1928; 3°46' N, 81°37' W; depth bottom, 2264 m; weather, crq; sea, CL; wind, SW 4; fair conditions; heavy current; bottom mud in lower water-bottle																	
	0	26.48	32.88	21.31	....	...	8.33	20	....	0	26.48	32.88	21.31	21.31	0.0000	0.0000	0.00649
	6	26.49	32.88	21.31	....	...	8.28	19	....	5	26.50	32.88	21.30	21.32	0.0341	0.0325	650
h	25	26.50	32.85	21.28	....	...	8.31	20	....	25	26.50	32.85	21.28	21.39	0.1710	0.1628	653
9.7	47	22.13	34.21	23.60	....	...	8.14	35	....	50	21.30	34.35	23.94	24.17	0.3093	0.2942	398
41°	68	16.99	34.89	25.45	....	...	7.96	153	....	75	16.65	34.91	25.55	25.90	0.3944	0.3748	246
	93	15.92	34.94	25.74	....	...	7.91	166	....	100	15.65	34.94	25.80	26.26	0.456	0.433	224
	188	13.63	34.95	26.24	....	...	7.85	188	....	150	14.35	34.96	26.10	26.79	0.567	0.538	196
	284	12.27	34.86	26.44	....	...	7.77	214	....	200	13.45	34.94	26.27	27.19	0.667	0.633	181
										250	12.80	34.90	26.37	27.53	0.760	0.721	173
	359	9.76	34.71	26.79	....	...	7.68	257	....	300	11.95	34.83	26.48	27.87	0.849	0.806	164
h	432	8.70	34.65	26.91	....	...	7.67	268	....	400	9.10	34.67	26.87	28.74	1.003	0.952	127
8.9	516	7.81	34.62	27.02	....	...	7.64	257	....	500	8.00	34.62	27.00	29.35	1.132	1.073	115
52°	694	6.36	34.60	27.21	....	...	7.66	273	....	700	6.35	34.60	27.21	30.52	1.357	1.286	098
	1051	4.82	34.57	27.38	....	...	7.64	268	....	1000	4.95	34.57	27.36	32.11	1.64	1.56	084
	1600	3.66	34.59	27.51	....	...	7.68	268	....	1500	3.80	34.59	27.50	34.64	2.06	1.96	0.00073
	2264	2.17	.....	.....	....	...	7.75	...	....								
Station 39: November 6, 1928; 0°52' N, 81°14' W; depth bottom, (3200) m; weather, bc; sea, MS; wind, SSW 2; good conditions; depth of bottom taken from U. S. Hydrographic Office chart No. 1176, published October 1930																	
	0	24.83	32.99	21.89	....	...	8.24	16	....	0	24.83	32.99	21.89	21.89	0.0000	0.0000	0.00594
	6	24.84	33.00	21.90	....	...	8.22	17	....	5	24.85	33.00	21.90	21.92	0.0312	0.0297	593
h	27	24.83	33.05	21.94	....	...	8.28	17	....	25	24.85	33.05	21.94	22.05	0.1555	0.1480	590
9.3	52	15.98	34.74	25.57	....	...	7.92	48	....	50	16.30	34.55	25.43	25.66	0.2669	0.2537	256
10°	76	14.49	34.96	26.07	....	...	7.85	163	....	75	14.45	34.96	26.08	26.43	0.3267	0.3104	196
	102	.....[a]	34.96	.....	....	...	7.88	181	....	100	14.05	34.96	26.16	26.62	0.377	0.358	190
	205	13.11	34.89	26.30	....	...	7.79	185	....	150	13.50	34.92	26.25	26.94	0.475	0.451	181
	294	12.24	34.85	26.44	....	...	7.81	194	....	200	13.15	34.89	26.29	27.21	0.571	0.542	0.00179

[a] Thermometer off scale.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 39--Continued																	
	307	.....[a]	34.90	.....	....	...	7.72	201	....	250	12.80	34.88	26.36	27.52	0.664	0.629	0.00174
h	383	9.89	34.69	26.74	....	...	7.64	224	....	300	12.15	34.87	26.48	27.87	0.753	0.714	164
8.6	489	7.90	34.59	26.98	....	...	7.64	251	....	400	9.45	34.66	26.80	28.67	0.910	0.864	135
29°	682	6.68	34.58	27.15	....	...	7.63	253	....	500	7.80	34.59	27.00	29.35	1.043	0.989	115
	980	4.81	34.50	27.32	....	...	7.63	249	....	700	6.55	34.58	27.17	30.48	1.272	1.206	102
	1521	3.11	34.57	27.56	....	...	7.69	244	....	1000	4.75	34.50	27.32	32.07	1.57	1.49	088
	2022	2.24	34.63	27.68	....	...	7.71	244	....	1500	3.15	34.57	27.55	34.71	1.98	1.88	066
										2000	2.30	34.62	27.67	37.20	2.30	2.19	0.00056
Station 40: November 8, 1928; 1°32' S, 82°16' W; depth bottom, 1344 m; weather, bc; sea, M; wind, SSW 2; good conditions; about 10 meters of wire tangled at end of first series; lower water bottle not reversed and no bottom sample on weights, but red crayfish tangled with them																	
	0	22.20	33.70	23.20	....	...	8.21	24	....	0	22.20	33.70	23.20	23.20	0.0000	0.0000	0.00469
	6	22.20	33.69	23.19	....	...	8.21	29	....	5	22.20	33.69	23.19	23.22	0.0247	0.0235	470
h	25	17.65	34.58	25.05	....	...	8.01	111	....	25	17.65	34.58	25.05	25.16	0.1049	0.0998	293
9.4	49	15.33	34.89	25.83	....	...	7.87	161	....	50	15.30	34.91	25.86	26.09	0.1720	0.1633	215
29°	73	14.40	34.96	26.09	....	...	7.83	172	....	75	14.40	34.97	26.10	26.45	0.2262	0.2145	194
	97	13.93	34.99	26.21	....	...	7.85	159	....	100	13.90	34.99	26.22	26.68	0.276	0.262	184
	182	13.34	34.90	26.26	....	...	7.83	192	....	150	13.60	34.94	26.24	26.93	0.372	0.353	182
	260	12.38	34.82	26.39	....	...	7.69	202	....	200	13.25	34.89	26.27	27.19	0.469	0.444	181
										250	12.60	34.84	26.36	27.52	0.563	0.533	174
h	89	14.08[b]	35.00	26.18	....	...	7.85	169	....	300	11.60	34.78	26.51	27.90	0.651	0.617	162
8.7	275	12.04	34.81	26.45	....	...	7.69	198	....	400	9.70	34.66	26.76	28.63	0.809	0.768	139
29°	572	7.47	34.54	27.01	....	...	7.60	272	....	500	8.30	34.57	26.91	29.26	0.948	0.899	123
	1115	4.17	34.54	27.42	....	...	7.62	272	....	700	6.50	34.53	27.13	30.44	1.190	1.128	106
										1000	4.75	34.54	27.36	32.11	1.49	1.41	0.00084
Station 41: November 10, 1928; 1°37' S, 86°58' W; depth bottom, 2568 m; weather, bc; sea, MS; wind, S by E 2; good conditions; heavy current																	
	0	20.42	34.19	24.06	4.39	83	8.11	32	....	0	20.42	34.19	24.06	24.06	0.0000	0.0000	0.00387
	6	20.41	34.18	24.05	4.40	84	8.13	36	....	5	20.41	34.18	24.05	24.08	0.0203	0.0194	388
	23	18.45	34.52	24.82	3.54	65	8.05	46	....	25	18.35	34.54	24.85	24.96	0.0939	0.0894	312
h	45	14.78	35.01	26.04	2.41	42	7.94	58	....	50	14.65	35.02	26.09	26.32	0.1607	0.1525	193
8.3	64	14.59	35.03	26.10	2.17	38	7.92	139	....	75	14.55	35.03	26.11	26.46	0.2119	0.2009	193
35°	85	14.55	35.02	26.11	2.33	40	7.92	151	....	100	14.50	35.03	26.12	26.58	0.263	0.249	193
	174	13.84	35.02	26.26	2.26	39	7.90	154	....	150	14.10	35.02	26.20	26.89	0.363	0.344	187
	271	12.68	34.93	26.42	0.72	12	7.76	201	....	200	13.60	35.00	26.29	27.21	0.460	0.436	179
	323	11.00[b]	34.80	26.64	0.29	5	7.66	225	....	250	13.05	34.94	26.35	27.51	0.553	0.522	174
	403	9.84	34.72	26.78	0.31	5	7.66	245	....	300	12.20	34.84	26.44	27.83	0.644	0.605	168
	576	6.88	34.59	27.13	0.93	14	7.64	253	....	400	9.95	34.72	26.76	28.63	0.805	0.758	139
	846	5.48	34.58	27.30	1.41	20	7.66	245	....	500	7.80	34.64	27.04	29.39	0.938	0.883	111
h	1353	3.58	34.60	27.53	1.36	19	7.65	241	....	700	6.10	34.57	27.22	30.53	1.158	1.090	096
9.1										1000	4.85	34.59	27.39	32.14	1.44	1.36	081
48°	245	13.14	34.93	26.33	....	...	7.83	172	....	1500	3.15	34.60	27.58	34.74	1.82	1.72	0.00063

[a] Thermometer off scale. [b] Temperature from pressure thermometer and wire depth.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

L.M.T. and wire angle	Observed values: Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	Interpolated values: A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Computed values: Density (σ_{tP})	Anomalies: Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 42: November 13, 1928; 1°32' S, 93°10' W; depth bottom, 3539 m; weather, bc; sea, MS; wind, SE 1/2; heavy current caused tangling of wire with plankton pump																	
	0	18.72	34.70	24.88	....	...	8.06	45	....	0	18.72	34.70	24.88	24.88	0.0000	0.0000	0.00308
	5	18.72	34.70	24.88	....	...	8.06	50	....	5	18.72	34.70	24.88	24.91	0.0162	0.0155	308
h	23	18.50	34.76	24.98	....	...	8.04	52	....	25	18.45	34.77	25.00	25.11	0.0800	0.0760	298
8.6	44	17.64	34.85	25.26	....	...	7.99	68	....	50	17.20	34.92	25.42	25.65	0.1533	0.1454	257
36°	65	15.64	35.04	25.88	....	...	7.88	84	....	75	14.80	35.04	26.06	26.41	0.2135	0.2024	198
	84	14.33	35.04	26.17	....	...	7.91	150	....	100	13.80	35.02	26.27	26.73	0.263	0.249	179
	174	12.87	34.93	26.38	....	...	7.94	158	....	150	13.05	34.95	26.36	27.05	0.355	0.337	171
	274	12.26	34.88	26.46	....	...	7.73	200	....	200	12.70	34.92	26.41	27.33	0.446	0.422	168
										250	12.40	34.89	26.44	27.60	0.534	0.505	166
	468	8.66	34.66	26.93	....	...	7.66	224	....	300	12.05	34.86	26.57	27.96	0.619	0.586	156
h	573	7.38	34.61	27.08	....	...	7.64	237	....	400	10.15	34.73	26.73	28.60	0.775	0.735	141
11.2	803	5.63	34.56	27.27	....	...	7.66	241	....	500	8.20	34.64	26.98	29.33	0.912	0.864	118
40°	1155	3.96	34.57	27.47	....	...	7.75	248	....	700	6.40	34.58	27.18	30.49	1.142	1.083	101
	1760	2.62	34.64	27.65	....	...	7.69	237	....	1000	4.65	34.56	27.38	32.13	1.43	1.36	082
	2368	1.92	34.65	27.72	....	...	7.69	237	....	1500	3.10	34.61	27.59	34.75	1.81	1.72	062
										2000	2.30	34.65	27.69	37.23	2.12	2.02	054
										2500	1.90	34.65	27.72	39.61	2.38	2.28	0.00052
Station 43: November 15, 1928; 2°30' S, 95°43' W; depth bottom, 3352 m; weather, bc; sea, M; wind, SE 3; good conditions; not much current																	
	0	19.56	34.80	24.74	....	...	8.09	52	....	0	19.56	34.80	24.74	24.74	0.0000	0.0000	0.00322
	8	19.55	34.83	24.77	....	...	8.11	42	....	5	19.55	34.82	24.77	24.80	0.0169	0.0161	319
h	30	19.52	34.85	24.80	....	...	8.04	50	....	25	19.55	34.85	24.81	24.92	0.0837	0.0796	316
8.5	54	16.53	34.95	25.60	....	...	7.93	80	....	50	17.00	34.91	25.47	25.70	0.1587	0.1505	252
10°	80	14.54	35.04	26.12	....	...	7.87	84	....	75	14.80	35.04	26.06	26.41	0.2182	0.2069	198
	103	13.45	35.01	26.33	....	...	7.90	92	....	100	13.55	35.02	26.32	26.78	0.267	0.253	174
	209	12.42	34.89	26.44	....	...	7.81	98	....	150	12.90	34.94	26.38	27.07	0.358	0.339	169
	312	11.74	34.83	26.53	....	...	7.69	110	....	200	12.50	34.91	26.44	27.37	0.447	0.423	165
										250	12.15	34.89	26.49	27.65	0.532	0.504	161
	289	11.86	34.89	26.55	....	...	7.70	107	....	300	11.80	34.85	26.53	27.92	0.617	0.584	159
	482	8.28	34.63	26.96	....	...	7.67	127	....	400	10.10	34.71	26.73	28.60	0.775	0.735	141
h	670	6.42	34.54	27.16	....	...	7.66	135	....	500	8.05	34.62	26.99	29.34	0.912	0.863	116
9.7	958	4.68	34.56	27.38	....	...	7.68	172	....	700	6.20	34.53	27.17	30.48	1.142	1.081	102
15°	1438	3.38	34.60	27.55	....	...	7.65	163	....	1000	4.50	34.57	27.41	32.16	1.43	1.35	078
	1926	2.43	34.63	27.66	....	...	7.69	168	....	1500	3.25	34.61	27.57	34.73	1.80	1.72	065
	2414	1.96	34.67	27.73	....	...	7.75	163	....	2000	2.35	34.64	27.68	37.21	2.12	2.02	055
										2500	1.90	34.67	27.74	39.63	2.38	2.28	0.00050
Station 44: November 17, 1928; 3°15' S, 99°48' W; depth bottom, 3423 m; weather, b; sea, MC; wind, SE 3; fair conditions																	
	0	20.67	34.86	24.49	....	...	8.03	38	....	0	20.67	34.86	24.49	24.49	0.0000	0.0000	0.00346
	5	20.66	34.85	24.49	....	...	8.06	32	....	5	20.66	34.85	24.49	24.52	0.0182	0.0173	346
	22	20.61	34.89	24.53	....	...	8.06	34	....	25	20.65	34.89	24.52	24.63	0.0907	0.0864	344
h	41	20.52	34.86	24.53	....	...	8.04	34	....	50	20.45	34.87	24.56	24.79	0.1807	0.1717	339
8.4	62	17.92	34.91	25.24	....	...	7.94	40	....	75	14.65	35.02	26.08	26.43	0.2514	0.2387	196
25°	83	14.22	35.04	26.19	....	...	7.88	58	....	100	13.75	35.02	26.28	26.74	0.300	0.285	178
	162	12.92	34.92	26.36	....	...	7.77	168	....	150	13.05	34.93	26.34	27.03	0.393	0.373	173
	239	12.47	34.90	26.44	....	...	7.71	185	....	200	12.70	34.91	26.40	27.33	0.484	0.459	169
	337	10.78	34.77	26.65	....	...	7.62	209	....	250	12.35	34.89	26.45	27.61	0.572	0.542	0.00165

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 44--Continued																	
	366	10.00	34.71	26.75	....	...	7.64	228	....	300	11.60	34.84	26.56	27.95	0.657	0.623	0.00157
	465	8.14	34.64	26.99	....	...	7.63	236	....	400	9.10	34.68	26.87	28.74	0.806	0.765	127
h	650	6.75	34.59	27.15	....	...	7.61	249	....	500	7.85	34.63	27.02	29.37	0.935	0.885	113
9.6	921	4.76	34.53	27.35	....	...	7.62	245	....	700	6.35	34.57	27.19	30.50	1.160	1.098	100
40°	1407	3.37	34.60	27.55	....	...	7.67	245	....	1000	4.50	34.53	27.38	32.13	1.45	1.37	081
	1902	2.43	34.63	27.66	....	...	7.66	237	....	1500	3.15	34.61	27.58	34.74	1.83	1.74	063
	2382	1.99	34.63	27.70	....	...	7.68	225	....	2000	2.30	34.63	27.67	37.21	2.14	2.04	056
	2890	1.75	34.65	27.73	....	...	7.72	224	....	2500	1.90	34.64	27.71	39.60	2.41	2.30	0.00053
Station 45: November 19, 1928; 4°35' S, 105°03' W; depth bottom 3342 m; weather, bc; sea, MR; wind, SE 4; strong trade wind; considerable drift																	
	0	22.43	35.26	24.31	....	...	8.12	38	....	0	22.43	35.26	24.31	24.31	0.0000	0.0000	0.00363
	5	22.45	35.24	24.29	....	...	8.13	36	....	5	22.45	35.24	24.29	24.31	0.0191	0.0182	364
	22	22.46	35.24	24.29	....	...	8.13	48	....	25	22.45	35.24	24.29	24.40	0.0961	0.0912	366
h	43	22.45	35.23	24.29	....	...	8.13	46	....	50	22.40	35.23	24.30	24.53	0.1922	0.1825	364
8.4	57	22.37	35.23	24.30	....	...	8.13	46	....	75	21.80	35.22	24.46	24.80	0.2865	0.2719	351
40°	80	21.69	35.21	24.48	....	...	8.12	46	....	100	18.60	35.14	25.25	25.70	0.369	0.350	276
	158	12.59	34.93	26.44	....	...	7.77	168	....	150	12.70	34.94	26.42	27.11	0.486	0.460	165
	238	11.78	34.88	26.56	....	...	7.71	178	....	200	12.15	34.90	26.50	27.43	0.572	0.542	159
	314	11.11	34.81	26.63	....	...	7.69	182	....	250	11.65	34.87	26.57	27.73	0.654	0.620	154
										300	11.25	34.83	26.61	28.00	0.735	0.696	152
	310	11.20	34.83	26.62	....	...	7.69	186	....	400	9.75	34.73	26.80	28.67	0.885	0.840	135
	388	9.91	34.74	26.78	....	...	7.63	200	....	500	8.15	34.66	27.00	29.35	1.018	0.965	115
h	554	7.47	34.63	27.08	....	...	7.62	224	....	700	5.95	34.55	27.22	30.53	1.242	1.176	096
9.6	789	5.20	34.53	27.30	....	...	7.65	225	....	1000	4.20	34.54	27.42	32.18	1.52	1.44	077
53°	1176	3.69	34.57	27.50	....	...	7.67	224	....	1500	3.05	34.60	27.58	34.74	1.89	1.79	063
	1556	2.94	34.60	27.60	....	...	7.68	220	....	2000	2.25	34.63	27.68	37.22	2.20	2.09	0.00055
	1884	2.40	34.63	27.66	....	...	7.70	209	....								
Station 46: November 21, 1928; 9°06' S, 108°20' W; depth bottom, 2905 m; weather, b; sea, MR; wind, SE 4; rough sea																	
	0	23.30	35.32	24.11	....	...	8.16	36	....	0	23.30	35.32	24.11	24.11	0.0000	0.0000	0.00382
	6	23.28	35.32	24.11	....	...	8.17	36	....	5	23.30	35.32	24.11	24.13	0.0201	0.0191	381
h	26	23.26	35.33	24.13	....	...	8.14	38	....	25	23.25	35.33	24.13	24.24	0.1004	0.0953	381
9.8	51	23.26	35.33	24.13	....	...	8.16	40	....	50	23.25	35.33	24.13	24.36	0.2007	0.1905	381
20°	74	22.78	35.37	24.29	....	...	8.19	34	....	75	22.75	35.37	24.30	24.64	0.2991	0.2840	366
	96	22.60	35.40	24.37	....	...	8.17	40	....	100	22.55	35.41	24.39	24.84	0.394	0.374	358
	196	13.96	34.87	26.11	....	...	7.83	139	....	150	17.75	35.40	25.66	26.34	0.552	0.523	238
	296	10.63	34.77	26.68	....	...	7.69	194	....	200	13.65	34.86	26.17	27.09	0.666	0.631	191
	392	9.40	34.71	26.85	....	...	7.66	205	....	250	11.50	34.81	26.56	27.72	0.757	0.717	155
										300	10.55	34.77	26.70	28.10	0.835	0.792	143
	146	18.36[a]	35.42	25.52	....	...	8.04	210	....	400	9.30	34.71	26.86	28.73	0.978	0.928	128
h	502	8.10	34.48[b]	.....	....	...	7.66	221	....	500	8.15	34.66	27.00	29.35	1.108	1.049	115
8.9	1103	4.05	34.58	27.47	....	...	7.68	224	....	700	6.30	34.58	27.20	30.51	1.334	1.263	099
25°	1713	2.58	34.61	27.63	....	...	7.68	225	....	1000	4.50	34.56	27.40	32.15	1.62	1.53	079
	2267	1.97	34.64	27.70	....	...	7.74	205	....	1500	2.95	34.61	27.60	34.77	1.99	1.89	061
	2820	1.91	34.68	27.74	....	...	7.74	192	....	2000	2.20	34.63	27.68	37.22	2.29	2.18	055
										2500	1.95	34.66	27.72	39.61	2.55	2.44	0.00052

[a] Temperature from pressure thermometer and wire-depth. [b] Salinity rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep-sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 47: November 23, 1928; 14°07' S, 111°50' W; depth bottom, 3080 m; weather, bcr; sea, R; wind, E 2-4; rough sea; larger wire angle for second series due to increase in wind																	
	0	23.88	35.96	24.42	....	...	8.23	17	....	0	23.88	35.96	24.42	24.42	0.0000	0.0000	0.00352
	5	23.86	35.94	24.41	....	...	8.23	17	....	5	23.86	35.94	24.41	24.43	0.0186	0.0177	352
h	25	23.86	35.97	24.44	....	...	8.23	20	....	25	23.86	35.97	24.44	24.55	0.0928	0.0880	351
8.4	53	23.77	35.99	24.48	....	...	8.23	20	....	50	23.80	35.99	24.47	24.70	0.1849	0.1754	349
10°	77	23.35	36.05	24.64	....	...	8.23	17	....	75	23.35	36.05	24.64	24.98	0.2748	0.2609	334
	95	22.86	36.15	24.86	....	...	8.23	20	....	100	22.70	36.15	24.91	25.36	0.359	0.341	308
	205	19.82	35.70	25.36	....	...	8.13	34	....	150	21.40	36.11	25.25	25.92	0.514	0.487	277
	314	11.36	34.57	26.39	....	...	7.77	155	....	200	20.05	35.75	25.35	26.25	0.660	0.625	271
	425	8.35	34.60	26.92	....	...	7.63	209	....	250	15.50	34.95	25.84	26.99	0.790	0.748	224
										300	12.00	34.60	26.30	27.69	0.897	0.849	181
	381	9.41	34.61	26.77	....	...	7.61	217	....	400	8.95	34.61	26.84	28.71	1.061	1.005	130
h	477	7.72	34.58	27.00	....	...	7.63	208	....	500	7.45	34.57	27.04	29.40	1.189	1.126	111
10.7	661	6.01	34.53	27.20	....	...	7.66	220	....	700	5.75	34.52	27.23	30.55	1.406	1.332	095
36°	1141	3.73	34.54	27.47	....	...	7.66	233	....	1000	4.20	34.52	27.41	32.17	1.68	1.59	078
	1590	2.85	34.59	27.59	....	...	7.67	224	....	1500	3.00	34.58	27.57	34.74	2.05	1.95	064
	2044	2.11	34.63	27.68	....	...	7.70	205	....	2000	2.20	34.63	27.68	37.22	2.36	2.26	0.00055
Station 48: November 25, 1928; 19°06' S, 114°07' W; depth bottom, 2874 m; weather, bc; sea, MR; wind, E by S 5; strong trade wind; rolling and pitching																	
	0	23.63	36.44	24.86	....	...	8.23	13	....	0	23.63	36.44	24.86	24.86	0.0000	0.0000	0.00310
	5	23.64	36.48	24.88	4.58	93	8.23	16	....	5	23.64	36.48	24.88	24.90	0.0163	0.0155	307
h	26	23.63	36.42	24.84	4.51	91	8.23	16	....	25	23.63	36.42	24.84	24.95	0.0818	0.0775	313
9.5	51	23.59	36.41	24.85	....	...	8.24	16	....	50	23.60	36.41	24.85	25.08	0.1642	0.1556	312
25°	85	22.88	36.30	24.98	4.70	94	8.26	16	....	75	23.15	36.31	24.90	25.24	0.2461	0.2333	309
	100	22.74[a)]	36.29	25.00	....	...	8.26	16	....	100	22.74	36.29	25.00	25.45	0.326	0.309	301
	203	.....	35.95	.....	4.64	87	8.20	16	....	150	21.80	36.25	25.24	25.92	0.479	0.454	278
	309	14.45	34.80	25.95	....	...	8.09	32	....	200	20.45	35.98	25.40	26.30	0.623	0.591	266
										250	18.50	35.41	25.48	26.61	0.762	0.721	259
	365	10.26	34.42	26.47	3.16	50	7.85	126	....	300	15.10	34.90	25.89	27.26	0.889	0.842	221
	453	7.98	34.44	26.86	2.02	31	7.75	178	....	400	9.25	34.42	26.65	28.53	1.083	1.027	149
h	547	6.32	34.41	27.07	3.09	45	7.78	176	....	500	7.05	34.43	26.98	29.35	1.223	1.160	117
8.9	723	5.16	34.40	27.20	2.49	35	7.71	198	....	700	5.25	34.40	27.19	30.52	1.448	1.375	098
28°	1005	4.18	34.50	27.39	2.06	29	7.69	217	....	1000	4.20	34.50	27.39	32.15	1.73	1.64	080
	1484	2.98	34.62	27.61	2.36	32	7.69	213	....	1500	2.95	34.61	27.60	34.77	2.10	2.00	061
	1975	2.13	34.61	27.67	....	...	7.75	192	....	2000	2.10	34.63	27.68	37.23	2.40	2.30	0.00055
Station 49: November 27, 1928; 23°16' S, 114°45' W; depth bottom, 3098 m; weather, bcuq; sea, ML; wind, E by S 2; good conditions; lower water bottle full of muddy water; left-hand thermometer and brass tube missing, while end of wire was torn and chafed as if caught in crevasse of sharp rock																	
	0	23.38	36.17	24.72	....	...	8.27	13	....	0	23.38	36.17	24.72	24.72	0.0000	0.0000	0.00324
	5	23.38	36.17	24.72	....	...	8.27	13	....	5	23.38	36.17	24.72	24.74	0.0171	0.0162	323
h	25	23.32	36.12	24.71	....	...	8.27	13	....	25	23.32	36.12	24.71	24.82	0.0855	0.0811	326
10.0	49	22.60	36.06	24.87	....	...	8.26	13	....	50	22.55	36.06	24.88	25.11	0.1691	0.1603	308
18°	73	21.85	36.01	25.04	....	...	8.27	13	....	75	21.85	36.01	25.04	25.38	0.2489	0.2358	295
	96	21.61	35.95	25.07	....	...	8.26	13	....	100	21.60	35.94	25.06	25.51	0.326	0.309	294
	198	19.55	35.58	25.34	....	...	8.21	16	....	150	20.80	35.76	25.14	25.82	0.480	0.454	287
	299	14.94	34.89	25.92	....	...	8.04	34	....	200	19.50	35.56	25.34	26.24	0.629	0.594	271
	388	10.71	34.44	26.41	....	...	7.94	114	....	250	17.30	35.26	25.66	26.80	0.764	0.722	0.00241

a) Thermometer not functioning.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 49--Continued																	
	444	8.49	34.37	26.73	....	...	7.85	142	....	300	14.85	34.86	25.92	27.29	0.885	0.837	0.00218
	543	6.73	34.35	26.96	....	...	7.85	159	....	400	10.10	34.41	26.50	28.38	1.036	1.028	164
^{h}	731	5.17	34.32	27.14	....	...	7.83	151	....	500	7.35	34.36	26.89	29.25	1.238	1.173	125
9.0	1013	3.98	34.39	27.32	....	...	7.73	186	....	700	5.35	34.32	27.12	30.45	1.480	1.403	105
30°	1495	2.67	34.59	27.60	....	...	7.75	180	....	1000	4.00	34.38	27.31	32.08	1.78	1.69	087
	2089	2.06	34.65	27.70	....	...	7.75	184	....	1500	2.65	34.59	27.61	34.79	2.16	2.06	059
	2601	1.89	34.63	27.70	....	...	7.78	176	....	2000	2.10	34.64	27.69	37.24	2.46	2.35	054
	3098	1.86[a]	.....	.....	....	...	7.70	...	....	2500	1.90	34.64	27.71	39.60	2.72	2.61	053
										3000	1.85	34.64	27.72	41.95	2.98	2.88	0.00053
Station 50: November 29, 1928; 26°27' S, 115°21' W; depth bottom, 2837 m; weather, bcq; sea, ML; wind, ENE 3; good conditions																	
	0	23.20	36.02	24.67	....	...	8.23	13	....	0	23.20	36.02	24.67	24.67	0.0000	0.0000	0.00329
	5	23.21	35.99	24.64	....	...	8.23	13	....	5	23.21	35.99	24.64	24.66	0.0174	0.0165	330
^{h}	24	22.32	35.94	24.86	....	...	8.22	13	....	25	22.30	35.94	24.86	24.97	0.0851	0.0806	311
9.3	48	22.07	35.95	24.94	....	...	8.23	13	....	50	22.00	35.94	24.96	25.19	0.1659	0.1571	301
5°	62	21.29	35.85	25.08	....	...	8.23	13	....	75	21.00	35.80	25.12	25.46	0.2436	0.2307	287
	95	20.57	35.73	25.18	....	...	8.22	13	....	100	20.50	35.72	25.20	25.65	0.318	0.302	281
	190	19.00	35.54	25.45	....	...	8.18	16	....	150	19.70	35.61	25.33	26.01	0.464	0.439	269
	285	14.89	34.90	25.94	....	...	8.08	54	....	200	18.65	35.51	25.52	26.42	0.603	0.570	253
										250	16.35	35.16	25.81	26.95	0.730	0.689	227
^{h}	283	14.73	34.88	25.96	....	...	8.07	52	....	300	14.10	34.78	26.01	27.39	0.845	0.799	210
8.7	386	10.26	34.47	26.51	....	...	7.99	107	....	400	9.75	34.45	26.59	28.47	1.036	0.982	155
12°	493	7.42	34.38	26.88	....	...	7.88	134	....	500	7.35	34.38	26.90	29.26	1.184	1.121	124
	703	5.60	34.33	27.09	....	...	7.86	131	....	700	5.65	34.33	27.09	30.41	1.429	1.351	109
	1019	4.06	34.37	27.30	....	...	7.77	162	....	1000	4.15	34.37	27.29	32.06	1.74	1.65	090
	1552	2.45	34.59	27.63	....	...	7.75	170	....	1500	2.55	34.57	27.60	34.78	2.13	2.03	060
	2083	2.06	34.62	27.68	....	...	7.76	154	....	2000	2.10	34.63	27.68	37.23	2.43	2.33	0.00055
Station 51: December 1, 1928; 29°06' S, 114°48' W; depth bottom, 2898 m; weather, b; sea, S; wind, ENE 0-1; nearly calm																	
	0	22.78	35.63	24.49	....	...	8.22	...	....	0	22.78	35.63	24.49	24.49	0.0000	0.0000	0.00346
	5	22.71	35.63	24.51	....	...	8.22	16	....	5	22.71	35.63	24.51	24.53	0.0181	0.0173	344
^{h}	25	21.18	35.65	24.96	....	...	8.22	16	....	25	21.18	35.65	24.96	25.07	0.0861	0.0819	302
8.8	48	20.54	35.58	25.08	....	...	8.22	17	....	50	20.50	35.58	25.09	25.32	0.1641	0.1556	288
0°	72	20.10	35.60	25.21	....	...	8.22	...	....	75	20.10	35.60	25.21	25.55	0.2391	0.2266	279
	94	20.07	35.62	25.24	....	...	8.22	17	....	100	19.95	35.62	25.26	25.71	0.312	0.296	275
	190	17.51	35.19	25.56	....	...	8.16	...	....	150	18.65	35.35	25.40	26.08	0.454	0.430	263
	285	14.55	34.97	26.07	....	...	8.10	40	....	200	17.30	35.16	25.58	26.49	0.590	0.558	248
	376	10.52	34.57	26.54	....	...	7.96	92	....	250	15.75	35.05	25.86	27.01	0.713	0.675	222
										300	13.75	34.93	26.20	27.58	0.823	0.779	192
	368	10.10	34.64	26.67	....	...	7.99	82	....	400	9.40	34.47	26.66	28.54	1.001	0.950	148
	459	8.01[c]	34.37	26.80	....	...	7.89	...	....	500	7.25	34.36	26.90	29.26	1.145	1.086	124
^{h}	637	6.00[c]	34.33	27.04	....	...	7.89	...	....	700	5.60	34.32	27.09	30.41	1.390	1.319	109
10.5	910	4.55	34.33	27.22	....	...	7.81	...	....	1000	4.15	34.36	27.28	32.05	1.70	1.62	091
6°	1367	2.93	34.48	27.50	....	...	7.75	192	....	1500	2.65	34.53	27.56	34.74	2.10	2.01	064
	1823	2.21	34.63	27.68	....	...	7.78	176	....	2000	2.10	34.65	27.70	37.24	2.41	2.31	052
	2277	1.94	34.66	27.72	....	...	7.75	...	....	2500	1.90	34.65	27.72	39.61	2.67	2.56	0.00052
	2875[b]	1.80	34.64	27.72	....	...	7.76	176	....								

[a] Temperature from pressure thermometer and wire-depth; water bottle on bottom. [b] Piano wire. [c] Temperature from pressure-thermometer and wire-depth.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep-sea stations, 1928-1929--Continued

L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
	Observed values									Interpolated values				Computed values			
Station 52: December 3, 1928; 31°28' S, 112°51' W; depth bottom, 2851 m; weather, bc; sea, SL; wind, N; good conditions; long south swells																	
	0	22.48	35.39	24.40	....	...	8.21	8	....	0	22.48	35.39	24.40	24.40	0.0000	0.0000	0.00354
	4	22.50	35.41	24.41	4.68	93	8.21	8	....	5	22.50	35.41	24.41	24.43	0.0186	0.0177	353
h	25	20.71	35.44	24.92	....	...	8.21	8	....	25	20.71	35.45	24.93	25.04	0.0879	0.0834	304
8.8	50	20.17	35.62	25.20	....	...	8.20	8	....	50	20.17	35.62	25.20	25.43	0.1649	0.1561	278
7°	74	19.37	35.49	25.32	....	...	8.16	8	....	75	19.35	35.49	25.32	25.66	0.2371	0.2245	268
	97	18.41	35.25	25.38	5.07	94	8.17	8	....	100	18.25	35.22	25.40	25.85	0.307	0.291	262
	189	14.69	34.81	25.91	4.77	83	8.10	17	....	150	16.00	34.95	25.73	26.42	0.437	0.414	231
	291	11.52	34.68	26.45	....	...	7.98	76	....	200	14.25	34.78	25.98	26.90	0.554	0.525	210
	383	8.52	34.42	26.76	4.30	66	7.89	122	....	250	12.85	34.72	26.23	27.39	0.658	0.623	186
										300	11.25	34.67	26.49	27.88	0.750	0.710	162
	377	8.69	34.45	26.75	4.58	70	7.89	134	....	400	8.05	34.42	26.83	28.71	0.905	0.857	131
	475	6.87	34.38	26.97	4.54	67	7.87	151	....	500	6.65	34.36	26.98	29.35	1.036	0.981	116
h	657	5.68	34.29	27.05	5.09	73	7.88	138	....	700	5.45	34.28	27.07	30.40	1.273	1.208	111
9.7	937	4.42	34.31	27.22	4.33	60	7.83	168	....	1000	4.20	34.35	27.27	32.04	1.59	1.51	092
11°	1405	3.02	34.56	27.56	....	...	7.72	209	....	1500	2.80	34.58	27.58	34.75	1.99	1.90	062
	1880	2.18	34.62	27.68	3.45	46	7.74	194	....	2000	2.05	34.64	27.70	37.25	2.29	2.19	052
	2359	1.87	34.66	27.73	3.64	48	7.77	194	....	2500	1.85	34.66	27.73	39.62	2.54	2.44	0.00050
	2829[a]	1.82	34.69	27.76	3.55	46	7.77	194	....								
Station 53: December 5, 1928; 29°06' S, 108°44' W; depth bottom, 2871 m; weather, bc; sea, MC; wind, W 5; not very good conditions; considerable drift																	
	0	22.57	35.70	24.61	....	...	8.22	13	....	0	22.57	35.70	24.61	24.61	0.0000	0.0000	0.00334
	4	22.58	35.68	24.59	....	...	8.20	13	....	5	22.60	35.68	24.58	24.60	0.0177	0.0168	337
h	22	22.23	35.70	24.70	....	...	8.20	13	....	25	22.20	35.71	24.72	24.83	0.0874	0.0830	325
8.7	44	21.44	35.76	24.96	....	...	8.20	13	....	50	21.25	35.75	25.01	25.24	0.1693	0.1605	296
25°	66	20.83	35.73	25.12	....	...	8.20	13	....	75	20.55	35.71	25.17	25.51	0.2458	0.2330	283
	86	20.28	35.68	25.22	....	...	8.20	13	....	100	19.90	35.62	25.28	25.73	0.319	0.302	273
	174	17.81	35.15	25.45	....	...	8.18	13	....	150	18.60	35.32	25.39	26.07	0.461	0.436	264
	260	14.61	34.87	25.97	....	...	8.08	36	....	200	16.90	35.04	25.59	26.50	0.597	0.565	247
	345	10.99	34.58	26.47	....	...	8.00	94	....	250	15.00	34.89	25.90	27.05	0.719	0.681	218
										300	13.20	34.77	26.20	27.58	0.827	0.783	191
	309	12.85	34.76	26.26	....	...	8.03	62	....	400	9.20	34.46	26.68	28.55	1.005	0.952	146
h	360	10.66	34.53	26.50	....	...	7.99	96	....	500	7.00	34.35	26.93	29.29	1.147	1.086	121
9.7	543	6.39	34.32	26.99	....	...	7.89	123	....	700	5.45	34.27	27.06	30.39	1.391	1.319	112
45°	794	5.03	34.28	27.12	....	...	7.86	163	....	1000	4.15	34.36	27.28	32.05	1.71	1.62	091
	1238	3.31	34.47	27.46	....	...	7.73	180	....	1500	2.70	34.56	27.58	34.76	2.10	2.01	062
	1704	2.34	34.60	27.65	....	...	7.73	192	....	2000	2.10	34.63	27.68	37.23	2.41	2.31	055
	2187	1.96	34.64	27.71	....	...	7.75	188	....	2500	1.85	34.65	27.72	39.61	2.67	2.57	0.00052
Station 54: December 14, 1928; 29°17' S, 108°54' W; depth bottom, 3061 m; weather, bcoqr; sea, MS; wind, NE; good conditions; *Meteor* tube sampler used, getting 24-inch sample with water in top of glass tube																	
	0	23.43	35.54	24.24	....	...	8.22	9	....	0	23.43	35.54	24.24	24.24	0.0000	0.0000	0.00369
h	6	23.43	35.42	24.15	....	...	8.22	12	....	5	23.43	35.42	24.15	24.17	0.0197	0.0187	378
8.6	26	21.27	35.40	24.74	....	...	8.20	24	....	25	21.30	35.40	24.73	24.84	0.0936	0.0889	324
0°	50	19.75	35.40	25.15	....	...	8.18	17	....	50	19.75	35.40	25.15	25.38	0.1736	0.1647	282
	75	19.16	35.01	25.01	....	...	8.17	17	....	75	19.16	35.01	25.01	25.35	0.2504	0.2372	298
	100	18.74	35.35	25.37	....	...	8.16	20	....	100	18.74	35.35	25.37	25.82	0.324	0.308	265
	200	16.04	34.96	25.73	....	...	8.10	28	....	150	17.45	35.15	25.54	26.23	0.460	0.436	249
	290	12.69	34.67	26.22	....	...	8.03	88	....	200	16.04	34.96	25.73	26.65	0.588	0.557	233
	399	9.01	34.42	26.68	....	...	7.91	146	....	250	14.30	34.80	25.99	27.14	0.704	0.667	0.00210

a) Piano wire.

Table 2--Physical and chemical data and results of dynamic computations for _Carnegie_ deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 54--Continued																	
	305	12.00	34.67	26.35	....	...	8.02	111	....	300	12.25	34.65	26.29	27.68	0.808	0.765	0.00182
	399	8.64	34.35	26.68	....	...	7.91	147	....	400	8.75	34.39	26.70	28.58	0.979	0.928	143
h 9.9	585	6.13	34.18	26.91	....	...	7.88	158	....	500	6.90	34.24	26.85	29.22	1.123	1.064	129
5°	869	4.70	34.16	27.07	....	...	7.83	174	....	700	5.50	34.14	26.95	30.28	1.385	1.315	122
	1344	3.04	34.52	27.52	....	...	7.69	216	....	1000	4.15	34.25	27.20	31.97	1.73	1.65	098
	1815	2.22	34.64	27.69	....	...	7.74	205	....	1500	2.70	34.58	27.59	34.77	2.14	2.05	061
	2287	1.90	34.59	27.67	....	...	7.75	205	....	2000	2.10	34.62	27.68	37.23	2.44	2.34	055
	3061	.....	34.68[a)]	.....	....	...	....	...	....	2500	1.85	34.63	27.71	39.60	2.71	2.61	0.00053
Station 55: December 16, 1928; 32°03' S, 110°55' W; depth bottom, 2725 m; weather, bc; sea, RC; wind, SE 5; not very good conditions; rough sea after gale; rolling and pitching																	
	0	20.38	34.91	24.61	....	...	8.19	12	....	0	20.38	34.91	24.61	24.61	0.0000	0.0000	0.00334
	6	20.39	35.01	24.68	....	...	8.19	12	....	5	20.40	35.01	24.68	24.70	0.0174	0.0166	328
h	27	20.39	34.97	24.65	....	...	8.19	12	....	25	20.40	34.97	24.65	24.76	0.0868	0.0826	331
9.6	52	18.54	35.04	25.18	....	...	8.18	12	....	50	18.70	35.04	25.14	25.37	0.1680	0.1592	283
13°	76	17.67	35.00	25.37	....	...	8.17	12	....	75	17.70	35.00	25.36	25.70	0.2405	0.2278	265
	99	16.75	34.86	25.48	....	...	7.17	12	....	100	16.70	34.86	25.50	25.96	0.308	0.292	252
	199	14.29	34.70	25.91	....	...	8.08	28	....	150	15.50	34.76	25.69	26.38	0.437	0.414	235
	299	10.50	34.47	26.47	....	...	7.96	94	....	200	14.25	34.70	25.92	26.84	0.556	0.527	215
										250	12.35	34.60	26.23	27.39	0.662	0.627	186
	325	9.52	34.39	26.58	....	...	7.94	98	....	300	10.50	34.46	26.46	27.86	0.754	0.715	165
h	428	7.25	34.34	26.88	....	...	7.89	107	....	400	7.60	34.35	26.84	28.73	0.909	0.862	129
9.0	536	6.42	34.37	27.02	....	...	7.88	118	....	500	6.65	34.29	26.93	29.30	1.041	0.987	120
19°	748	5.43	34.22	27.02	....	...	7.77	131	....	700	5.65	34.22	27.00	30.32	1.291	1.224	117
	1073	3.93	34.30	27.26	....	...	7.76	178	....	1000	4.28	34.27	27.20	31.97	1.63	1.55	098
	1594	2.53	34.53	27.57	....	...	7.74	176	....	1500	2.70	34.49	27.52	34.70	2.06	1.97	068
	2156	1.91	34.62	27.70	....	...	7.72	186	....	2000	2.10	34.62	27.68	37.23	2.38	2.28	055
										2500	1.85	34.63	27.71	39.60	2.64	2.54	0.00053
Station 56: December 18, 1928; 31°49' S, 109°04' W; depth bottomm 3135 m; weather, b; sea, MS; wind, N 2; good conditions																	
	0	20.85	34.93	24.50	....	...	8.13	9	....	0	20.85	34.93	24.50	24.50	0.0000	0.0000	0.00345
	5	20.84	34.97	24.53	....	...	8.14	9	....	5	20.84	34.97	24.53	24.55	0.0181	0.0172	342
h	25	20.81	34.93	24.51	....	...	8.14	9	....	25	20.81	34.93	24.51	24.62	0.0904	0.0859	345
9.7	48	18.58	35.12	25.24	....	...	8.14	9	....	50	18.50	35.12	25.26	25.49	0.1718	0.1630	272
8°	62	18.16	35.01	25.26	....	...	8.12	9	....	75	17.60	34.91	25.32	25.66	0.2433	0.2306	268
	93	16.90	34.76	25.37	....	...	8.11	12	....	100	16.65	34.75	25.42	25.88	0.313	0.296	260
	187	13.70	34.64	25.99	....	...	8.02	32	....	150	14.90	34.68	25.76	26.45	0.441	0.418	229
	283	10.59	34.49	26.47	....	...	7.93	68	....	200	13.20	34.62	26.08	27.00	0.555	0.526	199
	374	7.73	34.29	26.77	....	...	7.85	106	....	250	11.65	34.55	26.32	27.48	0.654	0.620	177
										300	9.80	34.46	26.58	27.98	0.742	0.703	154
	372	7.77	34.32	26.79	....	...	7.84	107	....	400	7.30	34.30	26.85	28.74	0.890	0.844	128
	467	6.66	34.31	26.94	....	...	7.85	107	....	500	6.50	34.30	26.95	29.32	1.021	0.968	119
h	648	5.72	34.25	27.02	....	...	7.84	111	....	700	5.45	34.24	27.04	30.37	1.264	1.200	113
9.7	928	4.40	34.26	27.18	....	...	7.75	126	....	1000	4.15	34.29	27.23	32.00	1.59	1.51	095
20°	1396	3.06	34.49	27.50	....	...	7.66	162	....	1500	2.80	34.52	27.54	34.72	2.01	1.92	066
	1870	2.18	34.59	27.65	....	...	7.68	154	....	2000	2.05	34.60	27.66	37.21	2.33	2.23	056
	2347	1.86	34.60	27.68	....	...	7.70	151	....	2500	1.85	34.62	27.70	39.59	2.60	2.50	0.00054
	2823	1.81	34.64	27.72	....	...	7.72	151	....								

[a)] By titration of water in bottom-sample.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 57: December 20, 1928; 33°59' S, 106°43' W; depth bottom, 3139 m; weather, bc; sea, MC; wind, NE 4; fair conditions; considerable drift																	
	0	18.97	34.49	24.66	....	...	8.14	20	....	0	18.97	34.49	24.66	24.66	0.0000	0.0000	0.00330
	4	18.98	34.56	24.70	4.99	93	8.14	20	....	5	19.00	34.56	24.70	24.72	0.0173	0.0165	326
h 8.6 25°	23	18.82	34.51	24.71	....	...	8.14	20	....	25	18.80	34.51	24.72	24.83	0.0857	0.0816	325
	47	15.85	34.33	25.28	....	...	8.14	21	....	50	15.55	34.33	25.35	25.58	0.1634	0.1551	264
	69	14.99	34.44	25.56	....	...	8.13	25	....	75	14.75	34.42	25.60	25.95	0.2302	0.2185	242
	89	14.57	34.39	25.61	5.76	99	8.13	25	....	100	14.30	34.38	25.66	26.12	0.293	0.278	237
	180	12.30	34.34	26.04	5.27	87	8.05	60	....	150	13.05	34.35	25.90	26.59	0.412	0.391	214
	268	9.54	34.32	26.52	5.03	79	7.92	102	....	200	11.50	34.33	26.18	27.11	0.520	0.492	190
										250	10.00	34.32	26.44	27.61	0.613	0.581	165
	280	9.30	34.32	26.56	4.97	77	7.92	103	....	300	8.80	34.32	26.64	28.04	0.695	0.659	147
	370	7.34	34.33	26.86	....	...	7.87	131	....	400	7.00	34.34	26.92	28.82	0.836	0.793	121
h 9.6 40°	468	6.53	34.36	26.99	5.47	80	7.88	135	....	500	6.40	34.37	27.03	29.40	0.959	0.909	111
	666	5.68	34.36	27.11	....	...	7.86	139	....	700	5.50	34.35	27.12	30.45	1.186	1.126	106
	969	4.28	34.30	27.22	4.54	63	7.79	186	....	1000	4.15	34.32	27.25	32.02	1.50	1.43	094
	1495	2.96	34.60	27.59	....	...	7.71	241	....	1500	2.95	34.60	27.60	34.77	1.90	1.82	061
	2037	2.14	34.63	27.68	3.67	48	7.74	224	....	2000	2.20	34.63	27.68	37.22	2.20	2.12	0.00055
Station 58: December 22, 1928; 36°51' S, 104°05' W; depth bottom, 3810 m; weather, fw; sea, ML; wind, NE 3; fair conditions but heavy current																	
	0	16.98	33.97	24.74	....	...	8.12	20	....	0	16.98	33.97	24.74	24.74	0.0000	0.0000	0.00322
	5	16.84	33.98	24.78	....	...	8.12	20	....	5	16.84	33.98	24.78	24.80	0.0169	0.0161	318
	25	16.02	34.04	25.02	....	...	8.12	24	....	25	16.02	34.04	25.02	25.13	0.0815	0.0774	296
h 8.8 35°	46	15.38	34.00	25.13	....	...	8.12	...	....	50	14.85	34.01	25.26	25.49	0.1566	0.1484	272
	66	13.47	34.09	25.61	....	...	8.10	25	....	75	13.10	34.09	25.68	26.03	0.2235	0.2118	234
	85	12.79	34.08	25.74	....	...	8.10	32	....	100	12.30	34.08	25.83	26.30	0.283	0.268	220
	166	10.52	34.12	26.19	....	...	8.01	60	....	150	10.95	34.10	26.10	26.80	0.392	0.372	194
	253	8.48	34.42	26.76	....	...	7.94	110	....	200	9.70	34.23	26.42	27.35	0.489	0.462	166
	340	7.01	34.38	26.95	....	...	7.87	135	....	250	8.55	34.42	26.76	27.93	0.568	0.537	134
										300	7.65	34.41	26.88	28.29	0.636	0.601	123
h 10.4 48°	373	6.85	34.35	26.95	....	...	7.88	142	....	400	6.60	34.35	26.98	28:88	0.762	0.721	116
	472	6.28	34.40	27.06	....	...	7.90	142	....	500	6.15	34.40	27.08	29.45	0.879	0.833	107
	683	5.47	34.34	27.11	....	...	7.87	139	....	700	5.30	34.31	27.12	30.45	1.101	1.045	105
										1000	4.15	34.32	27.25	32.02	1.41	1.34	094
h 13.4 32°	447	6.41	34.34	27.00	....	...	....	...	....	1500	2.80	34.54	27.55	34.73	1.82	1.75	065
	729	5.20	34.27	27.10	....	...	7.85	158	....	2000	2.20	34.70	27.74	37.28	2.12	2.04	049
	1129	3.65	34.37	27.34	....	...	7.71	205	....	2500	1.90	34.74	27.79	39.68	2.35	2.26	0.00044
	1812	2.42	34.66	27.69	....	...	7.72	217	....								
	2464	1.91	34.74	27.79	....	...	7.74	226	....								
Station 59: December 24, 1928, 39°51' S, 101°04' W; depth bottom, 4116 m; weather, cq 10; sea, MC; wind, N 3; fairly good conditions; not much drift																	
	0	16.33	33.97	24.90	....	...	8.10	38	....	0	16.33	33.97	24.90	24.90	0.0000	0.0000	0.00306
	6	16.28	33.94	24.89	....	...	8.10	38	....	5	16.30	33.94	24.88	24.90	0.0162	0.0154	308
	27	15.48	34.02	25.13	....	...	8.08	38	....	25	15.50	34.02	25.13	25.24	0.0788	0.0747	285
h 9.0 18°	53	13.77	33.98	25.46	....	...	8.08	38	....	50	13.95	33.98	25.43	25.66	0.1503	0.1423	256
	78	12.41	34.03	25.77	....	...	8.08	46	....	75	12.50	34.03	25.75	26.10	0.2142	0.2029	228
	103	11.26	34.14	26.08	....	...	8.03	72	....	100	11.45	34.12	26.03	26.50	0.270	0.256	201
	207	8.13	34.24	26.68	....	...	7.93	135	....	150	9.65	34.20	26.40	27.10	0.367	0.348	166
	313	6.83	34.34	26.94	....	...	7.90	150	....	200	8.30	34.23	26.64	27.58	0.450	0.426	145
	421	6:40	34.38	27.03	....	...	7.90	158	....	250	7.50	34.28	26.80	27.98	0.522	0.495	0.00130

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 59--Continued																	
	572	5.83	34.30	27.04	....	...	7.90	162	....	300	6.95	34.32	26.91	28.33	0.589	0.557	0.00120
	681	5.46	34.29	27.08	....	...	7.90	172	....	400	6.45	34.38	27.02	28.92	0.710	0.674	112
h	910	4.49	34.32	27.22	....	...	7.80	201	....	500	6.15	34.34	27.03	29.40	0.828	0.785	111
10.4	1242	3.38	34.42	27.41	....	...	7.69	240	....	700	5.40	34.29	27.08	30.41	1.059	1.006	110
33°	1822	2.44	34.59	27.63	....	...	7.69	248	....	1000	4.15	34.35	27.28	32.05	1.370	1.309	091
	2376	2.00	34.72	27.77	....	...	7.73	248	....	1500	2.90	34.50	27.52	34.69	1.79	1.71	069
	2909	1.79	34.68	27.75	....	...	7.73	260	....	2000	2.25	34.63	27.68	37.22	2.11	2.03	055
	3473	1.36	34.71	27.80	....	...	7.75	260	....	2500	1.95	34.71	27.76	39.64	2.36	2.28	048
										3000	1.72	34.71	27.78	42.00	2.60	2.52	0.00046
Station 60: December 26, 1928; 40°24' S, 97°33' W; depth bottom, 4007 m; weather, b; sea, S; wind, N 1-2; good conditions																	
	0	14.97	33.91	25.15	....	...	8.07	50	....	0	14.97	33.91	25.15	25.15	0.0000	0.0000	0.00282
h	5	14.92	34.00	25.24	....	...	8.07	50	....	5	14.92	34.00	25.24	25.27	0.0147	0.0139	274
8.8	24	14.20	33.91	25.32	....	...	8.07	54	....	25	14.20	33.91	25.32	25.43	0.0717	0.0680	267
13°	47	13.62	33.99	25.51	....	...	8.06	54	....	50	13.45	34.00	25.55	25.78	0.1393	0.1320	245
	70	11.68	34.01	25.90	....	...	8.06	54	....	75	11.50	34.01	25.93	26.28	0.1995	0.1890	210
	92	10.83	33.99	26.04	....	...	8.03	62	....	100	10.60	33.99	26.08	26.55	0.253	0.240	196
	185	8.28[a]	34.15	26.58	....	...	7.96	122	....	150	9.10	34.08	26.40	27.11	0.348	0.330	166
	279	6.71	34.27	26.90	....	...	7.90	147	....	200	7.95	34.17	26.65	27.59	0.431	0.408	144
	370	6.18	34.26	26.97	....	...	7.89	168	....	250	7.05	34.24	26.83	28.01	0.502	0.475	126
										300	6.55	34.27	26.93	28.35	0.567	0.536	118
	408	6.02	34.31	27.03	....	...	7.90	166	....	400	6.05	34.29	27.01	28.92	0.687	0.652	113
h	510	5.70[a]	34.28	27.04	....	...	7.89	166	....	500	5.75	34.28	27.04	29.42	0.804	0.763	109
10.3	712	5.03	34.23	27.08	....	...	7.87	170	....	700	5.10	34.23	27.07	30.41	1.033	0.982	110
22°	1027	3.83	34.32	27.28	....	...	7.76	213	....	1000	3.90	34.31	27.27	32.04	1.35	1.28	091
	1556	2.82	34.56	27.57	....	...	7.65	248	....	1500	2.95	34.53	27.54	34.70	1.76	1.69	067
	2079	2.19	34.64	27.69	....	...	7.71	221	....	2000	2.25	34.63	27.68	37.22	2.08	2.00	055
	2600	1.90	34.65	27.72	....	...	7.73	212	....	2500	1.95	34.65	27.72	39.61	2.34	2.26	052
	3123	1.68	34.66	27.74	....	...	7.74	212	....	3000	1.70	34.66	27.74	41.97	2.60	2.52	050
	3617	1.23	34.65	27.77	....	...	7.75	196	....	3500	1.35	34.66	27.76	44.30	2.84	2.76	0.00048
Station 61: December 28, 1928; 38°29' S, 94°14' W; depth bottom, 3299 m; weather, cq; sea, MC; wind, WSW 3; good conditions; smooth sea; some current																	
	0	16.90	34.05	24.83	....	...	8.05	46	....	0	16.90	34.05	24.83	24.83	0.0000	0.0000	0.00313
h	5	16.88	34.07	24.86	....	...	8.05	50	....	5	16.88	34.07	24.86	24.89	0.0164	0.0156	310
8.8	26	15.24	34.04	25.20	....	...	8.05	54	....	25	15.25	34.04	25.20	25.31	0.0784	0.0745	279
18°	50	14.03	33.96	25.40	....	...	8.05	60	....	50	14.03	33.96	25.40	25.63	0.1495	0.1417	259
	72	12.30	33.98	25.75	....	...	8.03	68	....	75	12.20	33.99	25.78	26.13	0.2134	0.2024	225
	94	10.92	34.05	26.06	....	...	8.03	80	....	100	10.75	34.05	26.10	26.57	0.268	0.254	194
	192	9.49	34.04	26.30	....	...	7.94	111	....	150	9.95	34.03	26.23	26.93	0.368	0.348	182
	283	7.15	34.25	26.83	....	...	7.88	151	....	200	9.30	34.05	26.34	27.28	0.462	0.438	173
	392	6.14	34.35	27.04	....	...	7.88	163	....	250	7.75	34.17	26.68	27.86	0.545	0.516	141
										300	6.90	34.25	26.86	28.28	0.615	0.582	125
	371	6.22	34.28	26.98	....	...	7.89	176	....	400	6.10	34.31	27.02	28.93	0.739	0.702	112
	465	5.80[a]	34.29	27.04	....	...	7.88	176	....	500	5.70	34.27	27.04	29.42	0.855	0.812	109
h	646	5.26	34.21	27.04	....	...	7.88	176	....	700	5.05	34.21	27.06	30.40	1.085	1.032	111
10.0	832	4.62	34.22	27.12	....	...	7.83	212	....	1000	3.95	34.28	27.24	32.01	1.40	1.34	094
28°	1055	3.72	34.31	27.29	....	...	7.75	248	....	1500	2.90	34.51	27.53	34.70	1.83	1.75	068
	1552	2.82	34.53	27.54	....	...	7.66	293	....	2000	2.30	34.63	27.67	37.21	2.15	2.07	056
	2080	2.23	34.64	27.69	....	...	7.70	293	....	2500	1.95	34.70	27.76	39.64	2.41	2.32	0.00048
	2494	1.94	34.70	27.76	....	...	7.70	277	....								
	2870	1.79	34.73	27.79	....	...	7.73	268	....								

[a] Temperature from pressure-thermometer and wire-depth.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 62: December 30, 1928; 34°35' S, 91°52' W; depth bottom, 3610 m; weather, bc; sea, MC; wind, SE 4; good conditions; very little drift; considerable rolling, westerly drift balanced by westerly current																	
	0	19.25	34.24	24.40	....	...	8.12	32	....	0	19.25	34.24	24.40	24.40	0.0000	0.0000	0.00354
	5	19.28	34.28	24.44	....	...	8.12	32	....	5	19.28	34.28	24.44	24.47	0.0185	0.0177	350
h	24	18.71	34.33	24.60	....	...	8.11	34	....	25	18.70	34.33	24.60	24.71	0.0907	0.0862	336
9.1	46	16.62	34.27	25.06	....	...	8.10	28	....	50	16.20	34.26	25.16	25.39	0.1723	0.1635	282
8°	71	14.42	34.23	25.52	....	...	8.10	29	....	75	14.30	34.23	25.54	25.89	0.2422	0.2297	247
	97	13.28	34.19	25.73	....	...	8.06	48	....	100	13.15	34.19	25.75	26.21	0.305	0.289	229
	192	10.45	34.24	26.30	....	...	7.97	103	....	150	11.55	34.20	26.07	26.77	0.417	0.395	198
	290	7.72	34.30	26.79	....	...	7.88	163	....	200	10.30	34.24	26.32	27.25	0.517	0.489	175
	391	6.44	34.35	27.00	....	...	7.85	192	....	250	8.65	34.28	26.62	27.80	0.601	0.569	147
										300	7.60	34.30	26.80	28.22	0.675	0.639	131
	386	6.47	34.28	26.94	....	...	7.85	194	....	400	6.40	34.32	26.99	28.89	0.803	0.763	115
	483	6.01	34.31	27.03	....	...	7.88	188	....	500	6.00	34.30	27.02	29.40	0.923	0.876	112
h	674	5.18	34.28	27.11	....	...	7.87	188	....	700	5.05	34.27	27.11	30.45	1.150	1.094	106
10.3	962	3.97	34.09[b]	.....	....	...	7.78	233	....	1000	3.85	34.34	27.30	32.08	1.45	1.39	088
5°	1440	2.92	34.56	27.57	....	...	7.70	297	....	1500	2.85	34.58	27.58	34.75	1.84	1.77	062
	1905	2.35	34.62	27.66	....	...	7.71	257	....	2000	2.25	34.62	27.67	37.21	2.15	2.07	056
	2340	1.98	34.62	27.69	....	...	7.73	241	....	2500	1.95	34.64	27.71	39.60	2.42	2.33	0.00053
	2784	1.70[a]	34.67	27.75	....	...	7.74	257	....								
Station 63: January 1, 1929; 32°10' S, 89°04' W; depth bottom, 3393 m; weather, b; sea, S; wind, 0; good conditions																	
	0	20.52	34.63	24.36	....	...	8.07	21	....	0	20.52	34.63	24.36	24.36	0.0000	0.0000	0.00358
	5	20.32	34.72	24.48	....	...	8.08	24	....	5	20.32	34.72	24.48	24.51	0.0185	0.0177	347
h	24	19.55	34.73	24.69	....	...	8.08	24	....	25	19.50	34.73	24.70	24.81	0.0893	0.0851	327
8.8	47	17.01	34.59	25.22	....	...	8.08	25	....	50	16.95	34.59	25.23	25.46	0.1687	0.1603	275
0°	71	16.49	34.63	25.37	....	...	8.08	24	....	75	16.45	34.63	25.38	25.73	0.2398	0.2276	263
	94	15.84	34.58	25.48	....	...	8.08	24	....	100	15.65	34.56	25.51	25.97	0.307	0.292	251
	189	13.29	34.28	25.80	....	...	8.01	64	....	150	14.35	34.37	25.65	26.34	0.436	0.414	239
	283	9.60	34.24	26.44	....	...	7.90	163	....	200	12.95	34.27	25.86	26.79	0.558	0.529	220
	378	7.12	34.25	26.84	....	...	7.83	188	....	250	10.80	34.25	26.24	27.41	0.664	0.630	185
										300	9.00	34.24	26.54	27.94	0.754	0.716	156
	387	7.01	34.26	26.86	....	...	7.81	188	....	400	6.85	34.26	26.88	28.78	0.902	0.857	125
	481	6.16	34.27	26.98	....	...	7.81	188	....	500	6.05	34.26	26.98	29.36	1.029	0.977	116
h	660	5.23	34.20	27.04	....	...	7.81	200	....	700	5.05	34.20	27.06	30.40	1.265	1.204	111
10.0	940	4.02	34.30	27.25	....	...	7.74	237	....	1000	3.90	34.34	27.29	32.07	1.58	1.50	089
5°	1413	3.21	34.53	27.51	....	...	7.64	276	....	1500	3.10	34.55	27.54	34.70	1.98	1.90	067
	1885	2.43	34.60	27.64	....	...	7.66	292	....	2000	2.30	34.61	27.66	37.20	2.31	2.22	057
	2329	1.98	34.62	27.69	....	...	7.69	253	....	2500	1.90	34.64	27.71	39.60	2.58	2.48	0.00053
	2787	1.80	34.66	27.74	....	...	7.71	237	....								
Station 64: January 3, 1929; 31°54' S, 88°17' W; depth bottom, 3879 m; weather, b; sea, S; wind, 0; good conditions; vessel becalmed																	
	0	20.61	34.62	24.33	....	...	8.12	21	....	0	20.61	34.62	24.33	24.33	0.0000	0.0000	0.00361
	5	20.51	34.63	24.36	....	...	8.12	28	....	5	20.51	34.63	24.36	24.39	0.0189	0.0180	358
h	23	19.64	34.64	24.60	....	...	8.12	28	....	25	19.60	34.63	24.60	24.71	0.0919	0.0874	336
9.1	47	17.51	34.58	25.09	....	...	8.12	29	....	50	17.25	34.56	25.13	25.36	0.1738	0.1649	284
4°	69	16.36	34.54	25.33	....	...	8.12	32	....	75	16.25	34.54	25.36	25.71	0.2464	0.2336	265
	94	15.90	34.54	25.43	....	...	8.10	32	....	100	15.80	34.54	25.46	25.92	0.315	0.299	256
	187	12.96	34.15	25.76	....	...	8.03	72	....	150	14.55	34.22	25.49	26.18	0.449	0.426	254
	281	9.58	34.20	26.41	....	...	7.90	126	....	200	12.30	34.15	25.89	26.82	0.574	0.544	217
	375	7.43	34.25	26.79	....	...	7.81	174	....	250	10.50	34.17	26.24	27.41	0.679	0.644	0.00185

[a] Temperature from pressure thermometer and wire depth.   [b] Salinity rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Interpolated Temperature (t) °C	Interpolated Salinity (S) o/oo	Interpolated Density (σ_t)	Computed Density (σ_{tP})	Anomalies Pressure (ΔP)	Anomalies Dynamic depth (ΔD)	Anomalies Specific volume ($\Delta\alpha$)
Station 64--Continued																	
	378	7.41	34.27	26.81	....	...	7.79	174	....	300	9.10	34.21	26.51	27.91	0.770	0.731	0.00159
	469	6.34	34.28	26.96	....	...	7.82	186	....	400	7.10	34.27	26.85	28.75	0.921	0.875	128
h	660	5.19	34.21	27.05	....	...	7.84	176	....	500	6.10	34.26	26.98	29.36	1.050	0.997	116
10.3	944	3.98	34.30	27.25	....	...	7.76	213	....	700	4.95	34.21	27.07	30.41	1.285	1.223	110
10°	1417	3.04	34.50	27.51	....	...	7.68	241	....	1000	3.85	34.33	27.29	32.07	1.59	1.52	089
	1883	2.32	34.54	27.60	....	...	7.73	241	....	1500	2.95	34.52	27.53	34.70	2.00	1.92	068
	2320	1.98	34.61	27.68	....	...	7.74	241	....	2000	2.20	34.55	27.62	37.16	2.34	2.25	060
	3860[a]	1.70	34.65	27.73	....	...	7.75	209	....	2500	1.90	34.64	27.71	39.60	2.62	2.52	053
										3000	1.75	34.65	27.73	41.95	2.88	2.79	052
										3500	1.70	34.65	27.73	44.24	3.14	3.05	0.00053
Station 65: January 5, 1929; 31°07' S, 86°39' W; depth bottom, 3626 m; weather, b; sea, S; wind, WSW 3; good conditions																	
	0	20.22	34.53	24.37	....	...	8.10	24	....	0	20.22	34.53	24.37	24.37	0.0000	0.0000	0.00357
	5	20.15	34.59	24.42	....	...	8.10	24	....	5	20.15	34.59	24.42	24.45	0.0187	0.0178	352
h	24	19.22	34.50	24.60	....	...	8.10	25	....	25	19.20	34.50	24.61	24.72	0.0909	0.0865	335
9.1	47	16.96	34.47	25.14	....	...	8.10	25	....	50	16.50	34.46	25.24	25.47	0.1714	0.1626	274
10°	71	15.61	34.42	25.40	....	...	8.10	28	....	75	15.60	34.41	25.40	25.75	0.2420	0.2296	261
	93	15.03	34.30	25.44	....	...	8.10	34	....	100	14.85	34.26	25.45	25.91	0.310	0.294	257
	189	12.17	34.07	25.85	....	...	8.01	98	....	150	13.30	34.09	25.64	26.33	0.441	0.418	240
	283	9.25	34.24	26.50	....	...	7.89	158	....	200	11.80	34.08	25.93	26.86	0.561	0.532	213
	377	7.04	34.23	26.82	....	...	7.81	186	....	250	10.35	34.16	26.26	27.43	0.665	0.630	182
										300	8.75	34.21	26.56	27.96	0.754	0.715	155
	382	6.98	34.25	26.85	....	...	7.82	192	....	400	6.80	34.26	26.88	28.78	0.901	0.855	125
	476	6.11	34.29	27.00	....	...	7.82	188	....	500	5.95	34.28	27.01	29.39	1.027	0.974	113
h	669	5.09	34.16	27.02	....	...	7.83	188	....	700	4.95	34.16	27.03	30.37	1.263	1.200	113
10.3	955	3.86	34.28	27.25	....	...	7.83	192	....	1000	3.70	34.30	27.28	32.06	1.58	1.51	090
15°	1434	2.96	34.53	27.54	....	...	7.66	261	....	1500	2.80	34.53	27.54	34.71	1.99	1.90	066
	1901	2.34	34.53	27.59	....	...	7.69	261	....	2000	2.25	34.55	27.62	37.16	2.32	2.22	060
	2333	2.00	34.61	27.68	....	...	7.69	253	....	2500	1.90	34.64	27.71	39.60	2.60	2.50	053
	3606[a]	1.65	34.67	27.75	....	...	7.75	237	....	3000	1.70	34.67	27.75	41.98	2.85	2.76	049
										3500	1.65	34.67	27.75	44.27	3.10	3.01	0.00051
Station 66: January 7, 1929; 27°04' S, 84°01' W; depth bottom, 3812 m; weather, O; sea, CR; wind, ESE 5; strong trade wind; vessel yawing; tried piano wire but angle too great																	
	0	19.43	34.69	24.69	....	...	8.10	29	....	0	19.43	34.69	24.69	24.69	0.0000	0.0000	0.00327
	6	19.49	34.69	24.68	....	...	8.10	29	....	5	19.50	34.69	24.67	24.70	0.0172	0.0165	329
h	23	19.07	34.69	24.78	....	...	8.10	29	....	25	19.00	34.70	24.81	24.92	0.0850	0.0810	316
9.0	48	17.86	34.78	25.16	....	...	8.10	29	....	50	17.80	34.80	25.19	25.42	0.1636	0.1553	279
15°	72[b]	.....	34.83	.....	....	...	8.10	28	....	75	17.95	34.85	25.18	25.52	0.2377	0.2255	282
	96	17.94[c]	34.94	25.26	....	...	8.12	21	....	100	17.85	34.94	25.28	25.73	0.311	0.295	273
	193	15.36	34.52	25.54	....	...	8.05	60	....	150	16.85	34.75	25.37	26.06	0.453	0.429	266
	293	10.34[d]	34.42	26.46	....	...	7.74	229	....	200	15.15	34.51	25.58	26.50	0.589	0.558	248
	391	8.35	34.45	26.81	....	...	7.67	245	....	250	11.95	34.44	26.18	27.34	0.704	0.668	191
										300	10.15	34.42	26.50	27.90	0.797	0.756	161
	428	7.51	34.44	26.92	....	...	7.67	285	....	400	8.15	34.45	26.84	28.72	0.950	0.902	130
h	536	6.08	34.34	27.04	....	...	7.76	229	....	500	6.40	34.35	27.01	29.38	1.079	1.023	113
9.9	751	4.96	34.37	27.20	....	...	7.67	237	....	700	5.15	34.36	27.17	30.50	1.303	1.236	100
15°	1076	3.88	34.48	27.41	....	...	7.66	265	....	1000	4.15	34.45	27.36	32.13	1.59	1.51	083
	1617	2.69	34.58	27.60	....	...	7.68	245	....	1500	2.90	34.56	27.57	34.74	1.97	1.88	064
	2132	2.07	34.61	27.67	....	...	7.71	245	....	2000	2.20	34.60	27.66	37.20	2.29	2.19	057
	2606	1.87	34.65	27.72	....	...	7.73	233	....	2500	1.90	34.65	27.72	39.61	2.55	2.46	0.00052

[a] Piano wire. [b] Water-bottle probably reversed but not closed when being lowered. [c] Temperature mean of 17°.90 and 17°.98. [d] Temperature mean of 10°.30 and 10°.39.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 67: January 8, 1929; 24°57' S, 82°15' W; depth bottom, 1089 m; weather, oc; sea, MR; wind, ESE 2; fair conditions																	
	0	19.27	34.91	24.90	....	...	8.11	21	....	0	19.27	34.91	24.90	24.90	0.0000	0.0000	0.00306
	4	19.21	34.88	24.90	....	...	8.10	25	....	5	19.20	34.89	24.90	24.93	0.0161	0.0153	306
	23	19.02	34.94	24.98	....	...	8.10	17	....	25	19.05	34.94	24.98	25.09	0.0799	0.0760	300
	45	17.50	34.74	25.21	....	...	8.11	20	....	50	17.35	34.75	25.26	25.49	0.1555	0.1474	272
h	67	17.11	34.81	25.36	....	...	8.10	20	....	75	16.95	34.79	25.38	25.73	0.2261	0.2144	263
13.8	89	16.36	34.70	25.45	....	...	8.09	24	....	100	16.20	34.63	25.43	25.89	0.294	0.280	259
20°	180	16.60	34.28	25.07	....	...	8.00	84	....	150	16.35	34.38	25.21	25.90	0.437	0.414	281
	271	11.19 b)	34.28	26.20	....	...	7.83	168	....	200	16.40	34.26	25.11	26.03	0.588	0.558	293
	363	8.92	34.50	26.76	....	...	7.64	233	....	250	12.10	34.26	26.02	27.18	0.719	0.683	206
	456	7.22 c)	34.41	26.94	....	...	7.69	245	....	300	10.40	34.38	26.41	27.81	0.818	0.777	170
	628	5.45	34.33	27.11	....	...	7.73	245	....	400	8.20	34.47	26.85	28.73	0.975	0.927	129
	930	4.31	34.41	27.31	....	...	7.66	249	....	500	6.65	34.37	26.99	29.36	1.105	1.049	115
	1069 a)	3.75	34.48	27.42	....	...	7.66	245	....	700	5.15	34.34	27.16	30.49	1.332	1.265	101
										1000	4.05	34.45	27.36	32.13	1.62	1.54	0.00083
Station 68: January 10, 1929; 21°28' S, 80°26' W; depth bottom, 4156 m; weather, o; sea, MS; wind, SE 3; good conditions																	
	0	19.18	35.12	25.08	....	...	8.14	29	....	0	19.18	35.12	25.08	25.08	0.0000	0.0000	0.00289
	6	19.17	35.07	25.05	....	...	8.14	29	....	5	19.17	35.07	25.05	25.07	0.0153	0.0145	291
h	25	19.16	35.07	25.05	....	...	8.14	29	....	25	19.16	35.07	25.05	25.16	0.0770	0.0730	293
9.3	46	18.60	35.01	25.15	....	...	8.14	29	....	50	18.25	35.00	25.23	25.46	0.1521	0.1439	275
10°	70	16.99	34.89	25.45	....	...	8.14	29	....	75	16.85	34.88	25.48	25.83	0.2218	0.2100	253
	95	16.56	34.85	25.52	....	...	8.13	34	....	100	16.50	34.84	25.53	25.99	0.288	0.273	249
	191	11.58	34.52	26.32	....	...	7.73	205	....	150	15.40	34.65	25.63	26.32	0.417	0.395	241
	287	10.28	34.63	26.63	....	...	7.63	261	....	200	11.40	34.52	26.35	27.28	0.527	0.499	173
	383	8.66	34.54	26.83	....	...	7.59	265	....	250	10.70	34.57	26.52	27.69	0.614	0.581	158
										300	10.05	34.63	26.67	28.07	0.694	0.657	145
	387	8.42	34.58	26.90	....	...	7.59	261	....	400	8.20	34.54	26.90	28.78	0.835	0.792	124
	483	6.95	34.42	26.99	....	...	7.64	249	....	500	6.75	34.41	27.01	29.38	0.961	0.911	113
h	679	5.49	34.40	27.16	....	...	7.64	257	....	700	5.35	34.41	27.18	30.51	1.184	1.123	099
10.6	973	4.24	34.50	27.38	....	...	7.65	138 e)	....	1000	4.15	34.50	27.40	32.17	1.46	1.39	079
20°	1464	2.98	34.51	27.52	....	...	7.67	261	....	1500	2.90	34.51	27.53	34.70	1.85	1.76	068
	1948	2.29	34.56	27.62	....	...	7.69	245	....	2000	2.20	34.57	27.64	37.18	2.18	2.08	058
	2394	1.99	34.63	27.70	....	...	7.73	241	....	2500	1.95	34.63	27.70	39.59	2.45	2.36	0.00054
	2842	1.80 d)	34.63	27.71	....	...	7.75	237	....								
Station 69: January 12, 1929; 16°49' S, 78°39' W; depth bottom, 3657 m; weather, o; sea, MS; wind, SE 4; good conditions																	
	0	21.13	35.24	24.66	....	...	8.12	62	....	0	21.13	35.24	24.66	24.66	0.0000	0.0000	0.00330
	5	21.16	35.22	24.64	....	...	8.12	68	....	5	21.16	35.22	24.64	24.66	0.0174	0.0165	330
	23	21.17	35.21	24.63	....	...	8.13	62	....	25	21.15	35.21	24.65	24.76	0.0872	0.0826	331
h	48	17.52	35.09	25.48	....	...	7.99	151	....	50	17.35	35.10	25.52	25.75	0.1636	0.1549	247
9.1	71	16.65	35.13	25.71	....	...	8.00	163	....	75	16.45	35.13	25.76	26.11	0.2263	0.2142	227
15°	94	14.77	34.83	25.91	....	...	7.86	198	....	100	14.55	34.82	25.95	26.41	0.283	0.268	209
	188	11.68	34.75	26.47	....	...	7.65	310	....	150	12.50	34.77	26.33	27.03	0.384	0.364	173
	282	10.59	34.75	26.67	....	...	7.63	314	....	200	11.45	34.74	26.51	27.44	0.473	0.447	158
	383	9.04	34.65	26.86	....	...	7.62	214	....	250	10.95	34.75	26.61	27.78	0.553	0.524	149
	472	7.74	34.54	26.97	....	...	7.58	214	....	300	10.35	34.74	26.70	28.10	0.630	0.596	142
	663	6.09	34.52	27.18	....	...	7.59	323	....	400	8.75	34.63	26.88	28.76	0.771	0.731	0.00126

a) Piano wire. b) Temperature mean of 11°.09 and 11°.29. c) Temperature mean of 7°.25 and 7°.19. d) Temperature from pressure thermometer and wire-depth. e) Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 69--Continued																	
	666	6.03	34.49	27.17	....	...	7.58	323	....	500	7.45	34.53	27.00	29.36	0.899	0.852	0.00115
	954	4.55	34.52	27.36	....	...	7.59	310	....	700	5.80	34.50	27.20	30.52	1.123	1.065	098
h	1434	3.12	34.59	27.57	....	...	7.64	303	....	1000	4.35	34.53	27.40	32.16	1.40	1.33	079
10.5	1906	2.39	34.58	27.63	....	...	7.69	292	....	1500	3.00	34.58	27.57	34.74	1.78	1.69	064
16°	2342	1.96	34.66	27.72	....	...	7.71	276	....	2000	2.25	34.60	27.66	37.20	2.09	2.00	057
	2781	1.83	34.69	27.76	....	...	7.72	276	....	2500	1.90	34.67	27.74	39.63	2.35	2.26	050
	3188	1.81	34.66	27.74	....	...	7.74	261	....	3000	1.85	34.67	27.74	41.96	2.61	2.52	0.00051
Station 70: January 13, 1929; 13°53' S, 77°54' W; depth bottom, 4742m; weather, bc; sea, MS; wind, SE 4; good conditions; salinities determined January 15, 1929																	
	0	21.23	35.08	24.52	....	...	8.05	103	....	0	21.23	35.08	24.52	24.52	0.0000	0.0000	0.00343
	5	21.21	35.09	24.53	....	...	8.05	110	....	5	21.21	35.09	24.53	24.55	0.0180	0.0171	341
	22	20.59	35.11	24.70	....	...	8.05	107	....	25	20.45	35.11	24.74	24.85	0.0880	0.0835	323
	44	16.03	35.01	25.77	....	...	7.88	178	....	50	15.40	34.95	25.86	26.09	0.1591	0.1507	215
h	66	13.83	34.87	26.14	....	...	7.67	229	....	75	13.10	34.80	26.24	26.59	0.2115	0.2004	181
14.9	89	12.73	34.76	26.28	....	...	7.68	233	....	100	12.55	34.76	26.31	26.78	0.258	0.245	175
20°	177	12.07	34.88	26.50	....	...	7.67	233	....	150	12.20	34.86	26.46	27.16	0.346	0.328	161
	266	11.23	34.82	26.61	....	...	7.66	245	....	200	11.90	34.88	26.53	27.46	0.431	0.408	156
	357	9.87	34.71	26.76	....	...	7.62	249	....	250	11.45	34.84	26.58	27.74	0.512	0.485	153
	447	8.47	34.65	26.95	....	...	7.63	265	....	300	10.75	34.77	26.66	28.06	0.591	0.560	146
	627	6.70	34.56	27.13	....	...	7.62	276	....	400	9.15	34.68	26.86	28.73	0.735	0.698	128
	911	4.84	34.51	27.32	....	...	7.63	297	....	500	7.80	34.62	27.03	29.39	0.863	0.818	112
										700	6.15	34.53	27.18	30.49	1.087	1.031	101
	1006	4.42	34.53	27.39	....	...	7.61	303	....	1000	4.45	34.53	27.38	32.14	1.37	1.30	081
	1487	2.99	34.61	27.60	....	...	7.66	285	....	1500	2.95	34.61	27.60	34.77	1.75	1.67	061
h	1995	2.23	34.64	27.69	....	...	7.69	276	....	2000	2.25	34.64	27.69	37.23	2.05	1.96	054
16.3	2447	1.95	34.66	27.72	....	...	7.72	245	....	2500	1.90	34.66	27.73	39.62	2.30	2.21	051
20°	2907	1.82	34.67	27.74	....	...	7.75	285	....	3000	1.85	34.67	27.74	41.96	2.56	2.48	051
	3333	1.83	34.66	27.73	....	...	7.75	245	....	3500	1.85	34.67	27.74	44.24	2.82	2.74	0.00054
	3760	1.84	34.68	27.75	....	...	7.76	241	....								
Station 71: February 6, 1929; 11°57' S, 78°37' W; depth bottom, 3357m; weather, bc; sea, M; wind, SE 4; good conditions but considerable current																	
	0	23.46	35.24	24.00	....	...	8.13	58	....	0	23.46	35.24	24.00	24.00	0.0000	0.0000	0.00392
	4	23.30	35.26	24.06	....	...	8.13	58	....	5	23.30	35.26	24.06	24.08	0.0205	0.0195	387
	19	23.30	35.24	24.05	....	...	8.11	58	....	25	21.10	35.20	24.64	24.75	0.0962	0.0914	332
h	40	18.15	35.14	25.36	....	...	7.96	139	....	50	16.70	35.11	25.69	25.92	0.1706	0.1618	231
8.8	60	15.85	35.09	25.86	....	...	7.83	182	....	75	14.45	35.03	26.13	26.48	0.2265	0.2146	191
35°	80	14.30	35.02	26.16	....	...	7.72	213	....	100	13.90	35.00	26.23	26.69	0.275	0.261	183
	166	12.91	34.94	26.38	....	...	7.70	226	....	150	13.15	34.95	26.34	27.03	0.370	0.350	172
	248	11.76	34.87	26.55	....	...	7.67	233	....	200	12.35	34.92	26.48	27.41	0.458	0.434	161
	332	10.74	34.79	26.68	....	...	7.66	237	....	250	11.70	34.88	26.57	27.73	0.541	0.512	154
										300	11.35	34.83	26.59	27.98	0.622	0.589	154
	295	11.42	34.85	26.60	....	...	7.66	237	....	400	9.65	34.72	26.81	28.68	0.773	0.734	134
	509	8.16	34.64	26.99	....	...	7.66	245	....	500	8.25	34.64	26.97	29.32	0.907	0.860	119
h	838	5.29	34.54	27.29	....	...	7.62	261	....	700	6.20	34.56	27.20	30.51	1.136	1.078	099
10.2	1399	3.15	34.62	27.59	....	...	7.68	229	....	1000	4.45	34.55	27.40	32.16	1.42	1,35	079
40°	1941	2.23	34.64	27.69	....	...	7.73	224	....	1500	2.95	34.63	27.62	34.79	1.78	1.70	059
	2447	1.87	34.67	27.74	....	...	7.75	217	....	2000	2.20	34.64	27.69	37.23	2.07	1.98	054
	2963	1.81	34.68	27.75	....	...	7.78	209	....	2500	1.85	34.67	27.73	39.62	2.33	2.24	0.00050

Table 2--Physical and chemical data and results of dynamic computations for <u>Carnegie</u> deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 72: February 8, 1929; 9°58' S, 82°10' W; depth bottom, 4480 m; weather, bc; sea, M; wind, SE 4; good conditions																	
	0	24.93	35.34	23.64	....	..	8.16	52	....	0	24.93	35.34	23.64	23.64	0.0000	0.0000	0.00426
	4	24.93	35.34	23.64	....	...	8.16	52	....	5	24.90	35.34	23.65	23.67	0.0224	0.0213	426
	22	24.88	35.38	23.68	....	...	8.17	52	....	25	24.70	35.39	23.74	23.85	0.1112	0.1058	418
	45	19.15	35.40	25.30	....	...	8.12	60	....	50	18.70	35.39	25.41	25.64	0.2004	0.1902	258
9.1h 20°	68	17.25	35.22	25.64	....	...	8.06	115	....	75	16.70	35.16	25.73	26.08	0.2648	0.2512	229
	90	15.77	35.07	25.87	....	...	7.94	154	....	100	14.80	35.04	26.06	26.52	0.321	0.304	199
	180	12.26	34.94	26.51	....	...	7.73	224	....	150	12.80	34.97	26.43	27.12	0.417	0.395	164
	271	11.30	34.81	26.59	....	...	7.71	229	....	200	12.05	34.91	26.53	27.46	0.502	0.476	156
	364	10.13	34.78	26.78	....	...	7.69	237	....	250	11.50	34.83	26.57	27.73	0.584	0.553	154
	457	8.93	34.71	26.92	....	...	7.67	241	....	300	10.95	34.79	26.64	28.03	0.664	0.628	148
	645	6.73	34.54	27.12	....	...	7.62	245	....	400	9.65	34.76	26.84	28.71	0.811	0.768	131
										500	8.35	34.66	26.97	29.32	0.943	0.893	119
	959	4.67	34.57	27.39	....	...	7.64	245	....	700	6.25	34.53	27.17	30.48	1.175	1.114	102
	1437	3.14	34.64	27.61	....	...	7.68	241	....	1000	4.50	34.58	27.42	32.18	1.46	1.38	077
	1904	2.31	34.62	27.67	....	...	7.72	229	....	1500	3.00	34.63	27.61	34.78	1.82	1.73	060
10.4h 25°	2335[a]	1.98	34.68	27.74	....	...	7.75	217	....	2000	2.20	34.64	27.69	37.23	2.11	2.02	054
	2781	1.82	.....	.....	....	...	....	...	....	2500	1.90	34.68	27.74	39.63	2.37	2.27	050
	3189	1.82	34.70	27.77	....	...	7.77	217	....	3000	1.85	34.69	27.76	41.98	2.62	2.53	049
	3603	1.84	34.69	27.76	....	...	7.78	216	....	3500	1.85	34.69	27.76	44.26	2.87	2.78	0.00051
Station 73: February 10, 1929; 10°45' S, 84°57' W; depth bottom, 4670 m; weather, bc; sea, S; wind, SE 0-1; good conditions																	
	0	25.27	35.42	23.60	....	...	8.21	44	....	0	25.27	35.42	23.60	23.60	0.0000	0.0000	0.00430
	5	25.26	35.45	23.62	....	...	8.19	46	....	5	25.25	35.45	23.62	23.64	0.0226	0.0215	428
	23	23.70	35.46	24.09	....	...	8.18	58	....	25	23.20	35.46	24.24	24.35	0.1067	0.1013	370
	47	19.21	35.41	25.30	....	...	8.05	122	....	50	18.70	35.38	25.40	25.63	0.1897	0.1799	259
9.7h 2°	70	17.46	35.30	25.65	....	...	7.95	155	....	75	16.50	35.25	25.84	26.19	0.2529	0.2398	219
	95	14.93	34.97	25.98	....	...	7.80	178	....	100	14.70	34.96	26.02	26.48	0.308	0.292	203
	188	12.20	34.91	26.50	....	...	7.70	224	....	150	12.95	34.92	26.36	27.05	0.407	0.386	171
	281	11.04	34.86	26.68	....	...	7.66	225	....	200	11.95	34.90	26.54	27.47	0.494	0.468	155
	375	9.92	34.71	26.76	....	...	7.65	225	....	250	11.40	34.88	26.62	27.78	0.574	0.543	149
										300	10.80	34.84	26.70	28.10	0.651	0.616	142
	393	9.64	34.71	26.80	....	...	7.64	225	....	400	9.55	34.70	26.81	28.68	0.796	0.755	134
	490	8.40	34.66	26.97	....	...	7.64	249	....	500	8.25	34.65	26.98	29.33	0.929	0.881	118
	687	6.31	34.60	27.22	....	...	7.58	249	....	700	6.25	34.59	27.22	30.53	1.155	1.096	097
9.1h 1°	979	4.67	34.52	27.35	....	...	7.62	...	....	1000	4.60	34.52	27.36	32.12	1.44	1.37	084
	1466	3.10[b]	34.61	27.59	....	...	7.67	245	....	1500	3.00	34.61	27.60	34.75	1.82	1.74	061
	1937	2.35	34.67	27.70	....	...	7.69	233	....	2000	2.30	34.65	27.69	37.23	2.13	2.03	054
	2373	2.01	34.63	27.69	....	...	7.72	224	....	2500	1.95	34.65	27.72	39.61	2.39	2.29	0.00052
Station 74: February 12, 1929; 11°00' S, 87°24' W; depth bottom, 4141 m; weather, b; sea, M; wind, SE 3; good conditions																	
	0	24.24	35.61	24.06	....	...	8.17	68	....	0	24.24	35.61	24.06	24.06	0.0000	0.0000	0.00387
	5	24.24	35.62	24.06	....	...	8.16	62	....	5	24.24	35.62	24.06	24.08	0.0203	0.0194	387
	22	23.72	35.62	24.21	....	...	8.14	64	....	25	23.60	35.60	24.23	24.34	0.1001	0.0952	371
9.6h 25°	44	19.47	35.45	25.26	....	...	8.06	76	....	50	19.25	35.39	25.27	25.50	0.1849	0.1754	271
	66	18.43	35.45	25.53	....	...	8.05	114	....	75	17.35	35.19	25.59	25.94	0.2528	0.2398	243
	89	16.52	35.14	25.75	....	...	7.89	168	....	100	15.40	35.07	25.96	26.42	0.312	0.296	209
	180	12.19	34.86	26.46	....	...	7.67	237	....	150	12.85	34.89	26.35	27.04	0.412	0.391	0.00171

[a] Water-bottle came up open, messenger-chain in valve. [b] Temperature from pressure thermometer and wire depth.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 74--Continued																	
h	272	11.04	34.81	26.64	....	...	7.64	241	....	200	11.90	34.84	26.50	27.43	0.501	0.474	0.00159
9.5	365	9.96	34.74	26.78	....	...	7.62	249	....	250	11.30	34.82	26.60	27.76	0.582	0.551	151
25°	459	8.89	34.68	26.90	....	...	7.60	157	....	300	10.70	34.79	26.68	28.08	0.660	0.625	144
	644	6.82	34.59	27.14	....	...	7.56	285	....	400	9.55	34.71	26.82	28.69	0.805	0.764	133
	923	4.77	34.53	27.35	....	...	7.57	292	....	500	8.40	34.65	26.96	29.31	0.939	0.891	120
										700	6.30	34.57	27.20	30.51	1.169	1.110	099
	994	4.48	34.54	27.38	....	...	7.60	253	....	1000	4.45	34.54	27.40	32.16	1.45	1.38	079
	1498	3.04	34.59	27.58	....	...	7.66	245	....	1500	3.00	34.59	27.58	34.75	1.82	1.74	063
h	1989	2.32	34.63	27.67	....	...	7.67	261	....	2000	2.30	34.63	27.67	37.21	2.13	2.04	056
11.1	2440	1.97	34.65	27.71	....	...	7.70	233	....	2500	1.95	34.66	27.72	39.61	2.40	2.30	052
28°	2897	1.84	34.67	27.74	....	...	7.73	220	....	3000	1.85	34.67	27.74	41.96	2.65	2.57	051
	3313	1.82	34.66	27.74	....	...	7.75	217	....	3500	1.80	34.67	27.75	44.25	2.91	2.83	0.00052
	3735	1.81	34.67	27.75	....	...	7.77	213	....								
Station 75: February 14, 1929; 14°15' S, 92°05' W; depth bottom, 3480 m; weather, bc; sea, MC; wind, SE 5; fair conditions; some rolling																	
	0	22.78	35.82	24.64	....	...	8.18	44	....	0	22.78	35.82	24.64	24.64	0.0000	0.0000	0.00331
	5	22.78	35.79	24.62	....	...	8.16	44	....	5	22.78	35.79	24.62	24.64	0.0175	0.0167	333
	23	22.75	35.80	24.63	....	...	8.16	46	....	25	22.75	35.80	24.63	24.74	0.0877	0.0832	333
h	45	20.43	35.59	25.11	....	...	8.14	46	....	50	20.00	35.52	25.18	25.41	0.1686	0.1599	280
9.9	67	18.68	35.46	25.48	....	...	8.11	46	....	75	18.55	35.46	25.50	25.84	0.2389	0.2263	251
20°	89	18.40	35.47	25.55	....	...	8.10	54	....	100	17.80	35.45	25.68	26.13	0.303	0.287	235
	189	12.39	34.68	26.29	....	...	7.73	213	....	150	13.75	34.81	26.11	26.80	0.417	0.394	194
	274	10.75	34.71	26.61	....	...	7.67	233	....	200	12.15	34.68	26.33	27.26	0.515	0.487	175
	374	8.99	34.63	26.85	....	....	7.67	257	....	250	11.15	34.70	26.53	27.70	0.602	0.569	156
										300	10.25	34.71	26.70	28.10	0.681	0.644	142
	357	9.78	34.67	26.75	....	...	7.68	241	....	400	8.65	34.62	26.90	28.78	0.821	0.776	124
	448	8.00	34.59	26.97	....	...	7.67	244	....	500	7.45	34.56	27.03	29.39	0.947	0.895	112
h	630	6.36	34.63[a]	......	....	...	7.64	249	....	700	5.85	34.51	27.20	30.52	1.168	1.106	098
9.2	907	4.71	34.51	27.34	....	...	7.64	257	....	1000	4.30	34.51	27.39	32.15	1.45	1.37	080
25°	1371	3.17	34.56	27.54	....	...	7.68	253	....	1500	2.90	34.58	27.58	34.75	1.82	1.74	063
	1829	2.41	34.62	27.66	....	...	7.72	237	....	2000	2.25	34.63	27.68	37.22	2.13	2.04	055
	2261	2.06	34.63	27.69	....	...	7.74	229	....	2500	1.95	34.64	27.71	39.60	2.40	2.30	0.00053
Station 76: February 16, 1929; 15°18' S, 97°28' W; depth bottom, 3197 m; weather, bcqd; sea, CR; wind, E 4; vessel rolling in rough sea; sonic depths showed rapid change in bottom this day																	
	0	23.40	35.86	24.49	....	...	8.15	50	....	0	23.40	35.86	24.49	24.49	0.0000	0.0000	0.00346
	4	23.39	35.90	24.52	....	...	8.15	50	....	5	23.40	35.90	24.52	24.54	0.0181	0.0173	343
	19	23.38	35.86	24.49	....	...	8.15	50	....	25	23.25	35.88	24.55	24.66	0.0901	0.0857	341
h	37	22.73	35.90	24.71	....	...	8.15	46	....	50	22.10	35.89	24.88	25.11	0.1758	0.1668	308
9.1	58	21.83	35.89	24.96	....	...	8.14	42	....	75	21.65	35.85	24.98	25.32	0.2563	0.2430	301
42°	76	21.66	35.85	24.98	....	...	8.13	42	....	100	21.25	35.80	25.06	25.51	0.335	0.317	294
	154	19.83	35.69	25.35	....	...	8.11	56	....	150	20.00	35.70	25.31	25.99	0.484	0.458	271
	233	14.77[b]	34.88	25.95	....	...	7.94	123	....	200	17.10	35.15	25.62	26.53	0.621	0.588	244
	324	10.97	34.66	26.53	....	...	7.69	241	....	250	13.95	34.82	26.08	27.23	0.738	0.698	201
	409	8.89	34.61	26.85	....	...	7.65	257	....	300	11.75	34.70	26.42	27.81	0.836	0.791	170
	572	6.85	34.53	27.09	....	...	7.65	297	....	400	8.95	34.61	26.84	28.71	0.994	0.942	0.00130

a) Salinity rejected. b) Temperature mean of 14°.74 and 14°.80.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 76--Continued																	
	731	5.71	34.48	27.20	....	...	7.62	277	....	500	7.60	34.56	27.01	29.37	1.124	1.064	0.00114
h	1054	4.31	34.50	27.38	....	...	7.65	273	....	700	5.90	34.49	27.18	30.50	1.349	1.278	100
10.5	1584	2.82	34.61	27.61	....	...	7.68	248	....	1000	4.55	34.49	27.34	32.10	1.64	1.56	086
45°	2115[a]	3.16	34.53	.....	....	...	7.64	249	....	1500	3.00	34.60	27.59	34.76	2.05	1.93	062
	2650	1.84	34.64	27.72	....	...	7.73	224	....	2000	2.25	34.64	27.69	37.23	2.33	2.23	054
	3181	1.84	34.67	27.74	....	...	7.75	229	....	2500	1.90	34.65	27.72	39.61	2.59	2.49	052
										3000	1.85	34.66	27.73	41.95	2.85	2.75	0.00052
Station 77: February 18, 1929; 14°20' S, 103°12' W; depth bottom, 4094 m; weather, bc; sea, RC; wind, E 4; vessel rolling heavily																	
	0	23.72	36.04	24.53	....	...	8.19	16	....	0	23.72	36.04	24.53	24.53	0.0000	0.0000	0.00342
	5	23.72	36.05	24.54	....	...	8.19	16	....	5	23.72	36.05	24.54	24.56	0.0180	0.0171	341
	23	23.70	36.05	24.54	....	...	8.19	16	....	25	23.70	36.05	24.54	24.65	0.0899	0.0854	342
h	46	23.69	36.04	24.54	....	...	8.19	16	....	50	23.50	36.04	24.59	24.82	0.1793	0.1703	337
9.1	69	22.64	36.02	24.82	....	...	8.19	13	....	75	22.15	36.01	24.96	25.30	0.2637	0.2504	303
22°	92	21.13	36.00	25.24	....	...	8.19	13	....	100	21.00	35.96	25.24	25.69	0.340	0.323	277
	182	18.09	35.41	25.58	....	...	8.08	29	....	150	19.35	35.69	25.48	26.16	0.481	0.455	255
	275	10.97	34.63	26.51	....	...	7.67	241	....	200	16.70	35.21	25.77	26.68	0.610	0.577	230
	367	9.23	34.65	26.82	....	...	7.62	253	....	250	12.30	34.66	26.29	27.45	0.717	0.679	180
	461	7.97	34.61	26.99	....	...	7.61	256	....	300	10.35	34.63	26.62	28.02	0.805	0.762	150
										400	8.75	34.64	26.90	28.78	0.949	0.900	124
	457	8.16	34.60	26.95	....	...	7.61	256	....	500	7.55	34.58	27.03	29.39	1.074	1.018	112
	642	6.20	34.52	27.17	....	...	7.63	265	....	700	5.75	34.52	27.22	30.54	1.293	1.226	096
h	922	4.53	34.54	27.38	....	...	7.63	273	....	1000	4.25	34.55	27.42	32.18	1.57	1.49	077
10.1	1393	3.10	34.60	27.58	....	...	7.64	264	....	1500	2.90	34.61	27.61	34.78	1.93	1.83	059
27°	1860	2.36	34.63	27.67	....	...	7.69	249	....	2000	2.20	34.64	27.69	37.23	2.22	2.12	054
	2288	1.95	34.66	27.72	....	...	7.72	225	....	2500	1.90	34.67	27.74	39.63	2.48	2.37	0.00050
	2721	1.84	34.67	27.74	....	...	7.73	232	....								
Station 78: February 20, 1929; 13°02' S, 108°03' W; depth bottom, 3337 m; weather, bc; sea, MC; wind, ESE 4; fair conditions																	
	0	24.55	35.95	24.22	....	...	8.17	32	....	0	24.55	35.95	24.22	24.22	0.0000	0.0000	0.00371
	5	24.55	35.98	24.24	....	...	8.17	34	....	5	24.55	35.98	24.24	24.26	0.0195	0.0185	369
	22	24.51	35.98	24.25	....	...	8.15	34	....	25	24.50	35.98	24.25	24.36	0.0973	0.0924	369
	45	24.38	36.03	24.33	....	...	8.14	32	....	50	23.80	36.09	24.54	24.77	0.1910	0.1812	342
h	66	22.72	36.18	24.92	....	...	8.14	32	....	75	22.45	36.18	25.00	25.34	0.2755	0.2614	299
9.0	91	22.04	36.17	25.11	....	...	8.14	34	....	100	21.90	36.15	25.14	25.59	0.352	0.334	286
22°	136	21.14	36.02	25.25	....	...	8.12	44	....	150	20.80	35.95	25.29	25.97	0.500	0.474	273
	181	19.60	35.68	25.40	....	...	8.07	52	....	200	17.80	35.50	25.72	26.63	0.635	0.602	235
	275	12.00	34.70	26.37	....	...	7.74	213	....	250	13.55	34.74	26.10	27.26	0.749	0.709	198
	370	9.39	34.66	26.81	....	...	7.68	229	....	300	11.05	34.69	26.54	27.93	0.843	0.798	157
	466	8.12	34.63	26.98	....	...	7.68	233	....	400	8.90	34.65	26.88	28.75	0.993	0.940	126
										500	7.80	34.62	27.03	29.38	1.121	1.059	112
	570	7.16	34.61	27.11	....	...	7.63	253	....	700	6.05	34.54	27.20	30.51	1.344	1.270	099
	860	5.07	34.49	27.28	....	...	7.65	257	....	1000	4.40	34.50	27.37	32.12	1.63	1.54	082
h	1333	3.35	34.57	27.53	....	...	7.68	261	....	1500	3.00	34.59	27.58	34.75	2.01	1.91	063
10.4	1804	2.46	34.63	27.66	....	...	7.70	249	....	2000	2.20	34.65	27.70	37.24	2.32	2.21	053
28°	2243	1.99	34.66	27.72	....	...	7.71	233	....	2500	1.90	34.67	27.74	39.63	2.57	2.46	050
	2803	1.82	34.67	27.74	....	...	7.74	229	....	3000	1.85	34.67	27.74	41.96	2.82	2.72	0.00051
	3138	1.82	34.67	27.74	....	...	7.73	224	....								

[a] Water bottle probably reversed at depth of about 1400 meters when being lowered; observed values rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 79: February 22, 1929; 12°36' S, 112°14' W; depth bottom, 3090[a] m; weather, bc; sea, MC; wind, E 4; fair conditions																	
	0	25.17	35.95	24.03	....	...	8.17	34	....	0	25.17	35.95	24.03	24.03	0.0000	0.0000	0.00389
	5	25.16	35.97	24.04	....	...	8.17	34	....	5	25.16	35.97	24.04	24.06	0.0205	0.0195	388
	21	25.16	35.97	24.05	....	...	8.17	34	....	25	25.15	35.98	24.06	24.17	0.1022	0.0971	388
	44	24.55	36.04	24.28	....	...	8.17	34	....	50	24.50	36.06	24.31	24.54	0.2011	0.1911	364
h	66	24.25	36.13	24.44	....	...	8.16	34	....	75	23.15	36.16	24.79	25.13	0.2911	0.2766	320
8.9	89	22.11	36.18	25.10	....	...	8.14	42	....	100	21.85	36.17	25.17	25.62	0.370	0.352	284
27°	135	21.12	36.01	25.25	....	...	8.11	48	....	150	20.10	35.85	25.40	26.08	0.515	0.488	263
	179	18.23	35.43	25.56	....	...	8.05	62	....	200	16.80	35.25	25.77	26.68	0.646	0.612	230
	226	15.00	34.93	25.93	....	...	7.95	134	....	250	13.15	34.70	26.15	27.31	0.757	0.718	194
	275	11.90	34.64	26.35	....	...	7.74	224	....	300	11.10	34.64	26.49	27.88	0.851	0.807	162
	368	9.35	34.66	26.81	....	...	7.68	245	....	400	8.65	34.64	26.91	28.79	1.002	0.950	123
	391	8.75	34.64	26.90	....	...	7.67	253	....	500	7.55	34.58	27.03	29.39	1.127	1.068	112
	489	7.71	34.59	27.01	....	...	7.67	257	....	700	5.85	34.53	27.22	30.54	1.346	1.276	096
h	690	5.96	34.53	27.21	....	...	7.66	276	....	1000	4.30	34.52	27.40	32.16	1.62	1.54	079
9.7	997	4.30	34.52	27.40	....	...	7.64	276	....	1500	2.85	34.58	27.58	34.75	1.99	1.90	062
24°	1504	2.88	34.58	27.58	....	...	7.68	323	....	2000	2.20	34.63	27.68	37.22	2.30	2.19	055
	1992	2.21	34.63	27.68	....	...	7.70	310	....	2500	1.90	34.65	27.72	39.61	2.56	2.45	0.00052
	2450	1.89	34.65	27.72	....	...	7.73	245	....								
Station 80: February 24, 1929; 12°39' S, 117°22' W; depth bottom, 3515 m; weather, c; sea, ML; wind, NE 3-4; fair conditions; considerable current																	
	0	26.04	35.94	23.75	....	...	8.20	36	....	0	26.04	35.94	23.75	23.75	0.0000	0.0000	0.00416
	5	26.05	35.94	23.75	....	...	8.20	32	....	5	26.05	35.94	23.75	23.77	0.0219	0.0209	416
	22	26.05	35.96	23.76	....	...	8.19	32	....	25	26.05	35.96	23.76	23.87	0.1095	0.1040	416
	44	26.06	35.95	23.75	....	...	8.19	29	....	50	25.90	35.95	23.80	24.03	0.2185	0.2075	412
h	66	24.34	36.05	24.35	....	...	8.18	28	....	75	23.90	36.13	24.54	24.88	0.3181	0.3021	344
9.0	88	23.58	36.21	24.70	....	...	8.18	28	....	100	23.35	36.24	24.79	25.24	0.405	0.385	321
23°	133	22.63	36.28	25.03	....	...	8.14	40	....	150	21.90	36.24	25.21	25.89	0.564	0.535	281
	180	20.40	35.87	25.34	....	...	8.11	56	....	200	18.85	35.59	25.53	26.43	0.706	0.670	253
	226	17.04	35.21	25.69	....	...	8.05	64	....	250	14.60	34.86	25.97	27.12	0.828	0.785	212
	273	12.90	34.64	26.15	....	...	7.89	172	....	300	12.10	34.63	26.30	27.69	0.932	0.884	181
	365	9.65	34.63	26.74	....	...	7.70	257	....	400	9.35	34.63	26.79	28.66	1.098	1.043	136
	406	9.62	34.64	26.76	....	...	7.72	249	....	500	7.70	34.62	27.04	29.40	1.229	1.166	111
	579	6.78	34.57	27.13	....	...	7.68	272	....	700	5.90	34.51	27.20	30.52	1.449	1.375	098
h	840	5.14	34.48	27.27	....	...	7.69	265	....	1000	4.40	34.50	27.37	32.13	1.73	1.65	082
9.9	1282	3.36	34.57	27.53	....	...	7.69	281	....	1500	3.00	34.59	27.58	34.75	2.11	2.01	063
40°	1729	2.54	34.59	27.61	....	...	7.73	276	....	2000	2.20	34.63	27.68	37.22	2.42	2.31	055
	2148	2.01	34.66	27.72	....	...	7.74	257	....	2500	1.90	34.66	27.73	39.62	2.68	2.57	0.00051
	2578	1.86	34.66	27.73	....	...	7.75	253	....								
Station 81: February 26, 1929; 13°03' S, 121°12' W; depth bottom, 2953 m; weather, bcz; sea, MC; wind, E 4; fair conditions																	
	0	26.53	35.82	23.50	....	...	8.19	38	....	0	26.53	35.82	23.50	23.50	0.0000	0.0000	0.00440
	5	26.52	35.82	23.51	....	...	8.19	38	....	5	26.52	35.82	23.51	23.53	0.0231	0.0220	439
	25	26.50	35.82	23.51	....	...	8.19	38	....	25	26.50	35.82	23.51	23.62	0.1156	0.1099	440
h	49	26.42	35.85	23.56	....	...	8.19	38	....	50	26.40	35.86	23.58	23.81	0.2305	0.2190	433
9.1	74	25.24	36.18	24.17	....	...	8.19	32	....	75	25.20	36.18	24.19	24.53	0.3372	0.3204	377
21°	98	23.69	36.23	24.68	....	...	8.18	36	....	100	23.65	36.23	24.70	25.15	0.430	0.409	330
	147	22.74	36.28	25.00	....	...	8.14	42	....	150	22.70	36.28	25.01	25.68	0.596	0.566	301
	195	20.35	35.83	25.32	....	...	8.10	52	....	200	20.20	35.77	25.32	26.22	0.749	0.710	273
	244	16.51	35.17	25.78	....	...	8.01	110	....	250	16.20	35.10	25.80	26.95	0.880	0.835	228
	293	12.84	34.71	26.22	....	...	7.85	58	....	300	12.50	34.70	26.28	27.66	0.989	0.938	183
	391	9.09	34.65	26.85	....	...	7.69	253	....	400	9.10	34.64	26.84	28.71	1.155	1.095	0.00130

[a] Mean of 3064 and 3116 meters.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 81--Continued																	
	358	10.23	34.64	26.65	....	...	7.65	253	....	500	7.70	34.59	27.01	29.37	1.285	1.217	0.00114
	446	8.41	34.62	26.93	....	...	7.69	245	....	700	5.90	34.51	27.20	30.52	1.508	1.429	098
h	626	6.47	34.53	27.14	....	...	7.69	253	....	1000	4.30	34.52	27.40	32.16	1.79	1.70	079
10.0	901	4.75	34.51	27.34	....	...	7.69	257	....	1500	2.90	34.61	27.61	34.78	2.15	2.05	059
28°	1368	3.21	34.59	27.56	....	...	7.69	272	....	2000	2.20	34.65	27.70	37.24	2.45	2.33	053
	1735	2.54	34.66	27.68	....	...	7.70	245	....	3500	1.85	34.66	27.73	39.62	2.70	2.58	0.00050
	2248	1.96	34.65	27.71	....	...	7.73	237	....								
	2681	1.82	34.66	27.74	....	...	7.75	233	....								
Station 82: February 28, 1929; 14°52' S, 126°07' W; depth bottom, 3631 m; weather, bc; sea, MC; wind, E; fair conditions																	
	0	27.21	36.32	23.66	....	...	8.21	34	....	0	27.21	36.32	23.66	23.66	0.0000	0.0000	0.00425
	4	27.21	36.32	23.66	....	...	8.21	34	....	5	27.21	36.32	23.66	23.68	0.0223	0.0213	425
	24	27.21	36.38	23.71	....	...	8.21	34	....	25	27.21	36.38	23.71	23.82	0.1113	0.1059	421
h	48	27.21	36.33	23.67	....	...	8.21	34	....	50	27.20	36.33	23.67	23.90	0.2227	0.2116	425
9.2	73	25.29	36.35	24.29	....	...	8.21	34	....	75	25.25	36.35	24.30	24.64	0.3268	0.3107	367
21°	98	24.34	36.46	24.65	....	...	8.19	34	....	100	24.35	36.46	24.66	25.11	0.419	0.398	334
	145	23.25	36.30	24.86	....	...	8.16	44	....	150	23.10	36.27	24.89	25.56	0.589	0.559	312
	193	21.65	36.05	25.13	....	...	8.11	46	....	200	21.35	36.01	25.18	26.08	0.748	0.710	287
	239	18.92[b]	35.57	25.50	....	...	8.09	54	....	250	17.15	35.31	25.73	26.87	0.885	0.840	234
	297	.....	34.88	.....	....	...	7.99	111	....	300	12.60	34.77	26.31	27.69	0.995	0.943	180
	396	9.23	34.51	26.71	....	...	7.74	225	....	400	9.05	34.53	26.76	28.63	1.163	1.103	139
h										500	6.90	34.50	27.06	29.43	1.294	1.227	109
10.8	256	16.61	.....	.....	....	...	7.99	86	....	700	5.60	34.49	27.22	30.54	1.509	1.432	096
27°	299	12.67	34.66	26.21	....	...	7.91	139	....	1000	4.35	34.52	27.39	32.15	1.79	1.70	080
										1500	2.90	34.58	27.58	34.75	2.16	2.06	063
	370	10.00	34.58	26.64	....	...	7.79	220	....	2000	2.10	34.65	27.70	37.25	2.46	2.35	052
	462	7.40	34.52	27.01	....	...	7.70	261	....	2500	1.85	34.67	27.74	39.63	2.71	2.60	0.00049
h	649	5.90	34.49	27.18	....	...	7.67	276	....								
10.0	931	4.61	34.57	27.40	....	...	7.66	315	....								
29°	1404	3.14	34.57	27.55	....	...	7.71	372	....								
	1871	2.26	34.63	27.68	....	...	7.73	253	....								
	2313	1.93	34.69	27.75	....	...	7.75	237	....								
	3596[a]	1.57	.....	.....	....	...	....	...	....								
Station 83: March 2, 1929; 17°00' S, 129°45' W; depth bottom, 3966 m; weather, b; sea, MS; wind, E 3; good conditions																	
	0	27.52	36.29	23.54	....	...	8.24	29	....	0	27.52	36.29	23.54	23.54	0.0000	0.0000	0.00436
	5	27.51	36.29	23.55	....	...	8.24	29	....	5	27.51	36.29	23.55	23.57	0.0229	0.0218	435
	24	27.51	36.29	23.55	....	...	8.24	29	....	25	27.50	36.29	23.55	23.66	0.1146	0.1089	436
h	49	27.46	36.49	23.71	....	...	8.24	25	....	50	27.45	36.49	23.72	23.95	0.2273	0.2159	420
9.3	73	26.29	36.42	24.04	....	...	8.24	24	....	75	26.20	36.42	24.06	24.40	0.3338	0.3172	390
5°	98	24.39	36.27	24.50	....	...	8.21	20	....	100	24.30	36.27	24.53	24.98	0.430	0.409	346
	146	23.53	36.30	24.78	....	...	8.20	34	....	150	23.35	36.29	24.83	25.50	0.605	0.575	318
	195	21.50	35.98	25.12	....	...	8.16	40	....	200	21.35	35.94	25.13	26.03	0.767	0.728	291
	244	19.19	35.57	25.43	....	...	8.12	50	....	250	18.80	35.55	25.51	26.64	0.911	0.864	256
	293	15.80	35.05	25.85	....	...	8.05	76	....	300	15.30	35.03	25.94	27.31	1.036	0.982	216
	343	12.73	34.94	26.42	....	...	7.95	119	....	400	9.60	34.51	26.66	28.53	1.228	1.165	0.00148

[a] Piano wire. [b] Thermometer off scale.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper- ature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phos- phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper- ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 83--Continued																	
	314	.....	34.69	.....	....	...	7.86	86	....	500	7.00	34.42	26.99	29.36	1.368	1.297	0.00116
	362	11.10	34.57	26.44	....	...	7.86	182	....	700	5.40	34.43	27.19	30.52	1.592	1.511	098
h	454	7.88	34.45	26.88	....	...	7.75	261	....	1000	4.35	34.51	27.38	32.14	1.87	1.78	081
10.2	645	5.65	34.41	27.15	....	...	7.73	292	....	1500	2.95	34.59	27.59	34.76	2.25	2.14	062
12°	926	4.59	34.50	27.34	....	...	7.70	285	....	2000	2.15	34.64	27.69	37.23	2.55	2.44	054
	1397	3.20	34.57	27.55	....	...	7.70	281	....	2500	1.90	34.65	27.72	39.61	2.81	2.70	0.00052
	1860	2.28	34.63	27.68	....	...	7.73	285	....								
	2292	1.97	34.65	27.71	....	...	7.75	257	....								
	3921[a)]	1.55	.....	.....	....	...	....	...	....								
Station 84: March 4, 1929; 17°11' S, 133°18' W; depth bottom, 4121 m; weather, b; sea, MS; wind, E 3; good conditions																	
	0	27.82	36.22	23.39	....	...	8.23	24	....	0	27.82	36.22	23.39	23.39	0.0000	0.0000	0.00451
	6	27.80	36.22	23.40	....	...	8.23	24	....	5	27.80	36.22	23.40	23.42	0.0237	0.0226	450
	23	27.71	36.32	23.50	....	...	8.21	24	....	25	27.70	36.32	23.51	23.62	0.1173	0.1116	440
h	48	27.52	36.42	23.64	....	...	8.21	24	....	50	27.50	36.42	23.65	23.88	0.2313	0.2199	427
11.5	71	25.53	36.42	24.27	....	...	8.20	24	....	75	25.35	36.41	24.32	24.66	0.3355	0.3190	365
12°	95	24.76	36.37	24.47	....	...	8.20	24	....	100	24.65	36.36	24.49	24.94	0.429	0.408	350
	142	23.95	36.30	24.65	....	...	8.19	24	....	150	23.85	36.28	24.67	25.34	0.609	0.579	334
	190	22.90	36.19	24.88	....	...	8.16	44	....	200	22.70	36.15	24.91	25.80	0.781	0.741	313
	237	20.68	35.84	25.24	....	...	8.11	50	....	250	19.80	35.68	25.35	26.48	0.935	0.887	272
	285	17.63	35.33	25.64	....	...	8.07	64	....	300	16.25	35.15	25.82	27.19	1.067	1.012	228
	333	13.30	34.75	26.16	....	...	7.98	115	....	400	9.65	34.48	26.62	28.50	1.266	1.203	152
	332	13.89	34.81	26.08	....	...	7.98	107	....	500	7.40	34.43	26.93	29.29	1.411	1.339	121
	380	10.40	34.50	26.51	....	...	7.86	151	....	700	5.30	34.40	27.18	30.51	1.643	1.559	099
	475	7.84	34.44	26.88	....	...	7.75	201	....	1000	4.25	34.51	27.39	32.15	1.92	1.83	080
	664	5.49	34.39	27.15	....	...	7.78	220	....	1500	2.85	34.58	27.58	34.75	2.30	2.19	062
h	949	4.42	34.50	27.37	....	...	7.75	241	....	2000	2.10	34.63	27.68	37.23	2.60	2.48	054
10.4	1420	3.01	34.57	27.57	....	...	7.74	233	....	2500	1.90	34.65	27.72	39.61	2.86	2.74	052
15°	1884	2.23	34.62	27.67	....	...	7.77	237	....	3000	1.75	34.67	27.75	41.97	3.12	3.00	0.00050
	2317	1.92	34.64	27.71	....	...	7.77	225	....								
	2758	1.79	34.66	27.74	....	...	7.77	237	....								
	3169	1.70	34.67	27.75	....	...	7.78	233	....								
	4076[a)]	1.51	.....	.....	....	...	....	...	....								
Station 85: March 6, 1929; 17°12' S, 136°37' W; depth bottom, 3791 m; weather, b; sea, S; wind, E 2; excellent conditions																	
	0	27.94	36.25	23.38	....	...	8.22	40	....	0	27.94	36.25	23.38	23.38	0.0000	0.0000	0.00452
	5	27.92	36.24	23.38	....	...	8.22	40	....	5	27.92	36.24	23.38	23.40	0.0237	0.0227	452
	23	27.91	36.24	23.38	....	...	8.22	40	....	25	27.90	36.24	23.38	23.49	0.1189	0.1132	453
	46	27.89	36.24	23.38	....	...	8.22	40	....	50	27.85	36.24	23.40	23.63	0.2377	0.2261	451
h	70	26.89	36.28	23.74	....	...	8.22	42	....	75	26.60	36.29	23.83	24.17	0.3510	0.3340	411
9.3	94	25.26	36.30	24.26	....	...	8.23	42	....	100	25.15	36.30	24.30	24.75	0.453	0.431	368
5°	140	24.45	36.31	24.51	....	...	8.22	52	....	150	24.20	36.30	24.58	25.25	0.640	0.608	342
	186	23.08	36.22	24.85	....	...	8.19	64	....	200	22.55	36.16	24.96	25.85	0.813	0.772	309
	234	21.24	35.95	25.17	....	...	8.11	66	....	250	20.45	35.81	25.28	26.41	0.967	0.918	278
	282	18.39	35.47	25.55	....	...	8.12	90	....	300	17.30	35.28	25.67	27.03	1.105	1.048	242
	329	15.12	35.00	25.97	....	...	8.07	102	....	400	11.40	34.60	26.41	28.27	1.324	1.256	0.00173

[a)] Piano wire.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

L.M.T. and wire angle	Observed values: Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	Interpolated values: A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Computed values: Density (σ_{tP})	Anomalies: Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 85--Continued																	
	330	15.63	35.05	25.89	....	...	8.06	90	....	500	7.35	34.37	26.89	29.25	1.482	1.405	0.00125
	376	12.86	34.74	26.24	....	...	8.02	168	....	700	5.35	34.39	27.17	30.50	1.719	1.630	100
	471	8.14	34.40	26.80	....	...	7.82	245	....	1000	4.25	34.50	27.38	32.14	2.00	1.90	081
h	661	5.54	34.37	27.13	....	...	7.80	297	....	1500	2.85	34.58	27.58	34.75	2.38	2.27	062
10.3	945	4.48	34.49	27.35	....	...	7.79	297	....	2000	2.15	34.63	27.68	37.22	2.69	2.56	055
2°	1414	3.01	34.54	27.54	....	...	7.77	285	....	2500	1.90	34.65	27.72	39.61	2.95	2.82	0.00052
	1889	2.22	34.62	27.67	....	...	7.76	285	....								
	2334	1.92	34.65	27.72	....	...	7.76	276	....								
	3746[a)]	1.53	.....	.....	....	...	....	...	....								
Station 86: March 9, 1929; 17°36' S, 141°55' W; depth bottom, 2132 m; weather, b; sea, MS; wind, E 2-3; good conditions; soundings during early morning indicated existence of ridge 2000 meters higher than general bottom																	
	0	28.23	36.18	23.23	....	...	8.29	20	....	0	28.23	36.18	23.23	23.23	0.0000	0.0000	0.00466
	5	28.22	36.19	23.24	....	...	8.29	20	....	5	28.22	36.19	23.24	23.26	0.0245	0.0233	465
	24	27.91	36.20	23.35	....	...	8.29	17	....	25	27.90	36.20	23.35	23.46	0.1213	0.1153	455
	48	27.51	36.20	23.48	....	...	8.29	17	....	50	27.45	36.20	23.50	23.73	0.2392	0.2273	441
h	72	25.98	36.25	24.00	....	...	8.26	17	....	75	25.90	36.25	24.03	24.37	0.3488	0.3315	392
8.9	96	25.11	36.22	24.25	....	...	8.25	17	....	100	24.90	36.21	24.31	24.76	0.448	0.426	367
5°	143	23.42	36.10	24.66	....	...	8.23	17	....	150	23.25	36.09	24.71	25.38	0.632	0.600	330
	191	22.17	36.00	24.95	....	...	8.19	20	....	200	21.90	35.97	25.00	25.90	0.800	0.759	304
	238	20.38	35.78	25.37	....	...	8.18	29	....	250	19.75	35.70	25.38	26.51	0.951	0.902	269
	286	18.14	35.45	25.60	....	...	8.10	40	....	300	17.25	35.32	25.72	27.08	1.085	1.029	237
	334	14.78	35.01	26.04	....	...	8.05	64	....	400	11.40	34.68	26.47	28.33	1.298	1.231	167
										500	8.60	34.48	26.79	29.14	1.459	1.383	136
	321	.....b)	35.24	.....	....	...	8.12	58	....	700	5.60	34.41	27.16	30.48	1.709	1.621	102
	367	.....b)	34.82	.....	....	...	8.03	96	....	1000	4.05	34.50	27.40	32.17	1.99	1.89	079
h	459	9.62	34.54	26.68	....	...	7.88	143	....	1500	2.60	34.60	27.62	34.80	2.35	2.24	058
9.6	642	6.09	34.41	27.10	....	...	7.83	205	....	2000	2.15	34.64	27.69	37.23	2.64	2.53	0.00054
14°	920	4.38	34.47	27.35	....	...	7.79	233	....								
	1380	2.80	34.58	27.58	....	...	7.82	241	....								
	1835	2.27	34.63	27.67	....	...	7.82	229	....								
	2087[a)]	2.09	.....	.....	....	...	....	...	....								
Station 87: March 11, 1929; 18°05' S; 145°33' W; depth bottom, 4315 m; weather, bcu; sea, MS; wind, NE 2-4; good conditions																	
	0	27.85	36.09	23.28	....	...	8.28	17	....	0	27.85	36.09	23.28	23.28	0.0000	0.0000	0.00461
	5	27.84	36.09	23.28	....	...	....	17	....	5	27.84	36.09	23.29	23.31	0.0242	0.0231	460
	24	27.84	36.11	23.30	....	...	8.27	17	....	25	27.84	36.11	23.30	23.41	0.1210	0.1151	460
	48	26.83	36.09	23.61	....	...	8.26	20	....	50	26.50	36.09	23.71	23.94	0.2369	0.2252	421
h	71	24.45	36.05	24.32	....	...	8.25	20	....	75	24.40	36.05	24.34	24.68	0.3401	0.3233	363
9.2	94	24.07	36.02	24.41	....	...	8.23	20	....	100	23.90	36.01	24.46	24.91	0.434	0.413	353
12°	187	21.20	35.77	25.05	....	...	8.19	21	....	150	22.40	35.88	24.79	25.47	0.611	0.581	321
	282	17.71	35.42	25.68	....	...	8.16	44	....	200	20.65	35.72	25.16	26.06	0.773	0.734	289
	377	12.37	34.77	26.36	....	...	8.00	86	....	250	18.85	35.54	25.49	26.62	0.917	0.870	258
	473	8.62	34.48	26.79	....	...	7.89	162	....	300	16.70	35.32	25.85	27.22	1.045	0.991	225
	662	5.46	34.35	27.12	....	...	7.86	209	....	400	11.10	34.66	26.51	28.38	1.249	1.186	0.00163

a) Piano wire. b) Thermometer off scale.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 87--Continued																	
	610	6.11	34.34	27.04	....	...	7.85	209	....	500	8.00	34.44	26.85	29.21	1.404	1.332	0.00130
	876	4.61 b)	34.45	27.30	....	...	7.82	253	....	700	5.40	34.35	27.13	30.46	1.649	1.566	104
h	1318	.....	34.56	.....	....	...	7.77	257	....	1000	4.15	34.50	27.40	32.17	1.94	1.84	079
10.3	1756	2.45	34.59	27.62	....	...	7.77	249	....	1500	2.80	34.58	27.58	34.75	2.31	2.20	062
26°	2177	2.07	34.63	27.69	....	...	7.78	245	....	2000	2.20	34.62	27.68	37.22	2.61	2.50	055
	3009	1.71	34.65	27.73	....	...	7.79	241	....	2500	1.95	34.65	27.72	39.61	2.88	2.76	052
	3670	1.48	34.68	27.77	....	...	7.80	229	....	3000	1.70	34.66	27.74	41.97	3.13	3.02	050
	4270 a)	1.40	.....	.....	....	...	....	...	....	3500	1.55	34.67	27.76	44.29	3.38	3.27	0.00049
Station 88: March 21, 1929; 16°42' S, 150°41' W; depth bottom, 3697 m; weather, bcq; sea, ML; wind, NNW; fair conditions; heavy rolling and long southerly swell																	
	0	28.48	35.88	22.92	....	...	8.23	16	....	0	28.48	35.88	22.92	22.92	0.0000	0.0000	0.00495
	5	28.46	35.82	22.88	....	...	8.23	...	....	5	28.46	35.82	22.88	22.90	0.0261	0.0249	499
	22	28.45	35.96	22.99	....	...	8.25	13	....	25	28.45	35.96	22.99	23.10	0.1301	0.1238	490
	47	28.45	35.88	22.93	....	...	8.25	13	....	50	28.45	35.88	22.93	23.16	0.2597	0.2469	495
h	70	27.16	36.08	23.50	....	...	8.24	12	....	75	26.90	36.08	23.58	23.92	0.3821	0.3632	435
9.4	94	25.59	36.08	24.00	....	...	8.24	12	....	100	25.40	36.08	24.05	24.50	0.490	0.466	392
0°	187	22.20	35.93	24.88	....	...	8.19	17	....	150	23.45	36.00	24.58	25.25	0.684	0.650	342
	282	18.12	35.50	25.64	....	...	8.09	24	....	200	21.75	35.89	24.98	25.88	0.855	0.812	306
	375	12.51	34.92	26.44	....	...	7.98	126	....	250	19.70	35.70	25.39	26.52	1.006	0.955	268
	470	8.88	34.50	26.76	....	...	7.89	...	....	300	17.10	35.40	25.81	27.18	1.138	1.080	229
	658	5.73	34.36	27.10	....	...	7.87	...	....	400	11.35	34.77	26.55	28.41	1.342	1.275	160
										500	8.15	34.45	26.84	29.19	1.496	1.420	131
	659	5.75	34.38	27.11	....	...	7.87	209	....	700	5.40	34.39	27.16	30.49	1.740	1.652	101
h	940	4.06 c)	34.48	27.38	....	...	7.82	245	....	1000	3.85	34.50	27.42	32.19	2.02	1.92	076
10.5	1412	2.85	34.59	27.59	....	...	7.81	249	....	1500	2.70	34.60	27.61	34.79	2.37	2.26	059
5°	1886	2.25	34.61	27.66	....	...	7.79	240	....	2000	2.15	34.61	27.67	37.21	2.67	2.55	056
	2329	1.96	34.62	27.69	....	...	7.81	241	....	2500	1.85	34.63	27.71	39.60	2.94	2.82	053
	2787	1.78	34.63	27.71	....	...	7.82	241	....	3000	1.70	34.65	27.73	41.96	3.20	3.09	0.00051
	3230	1.63	34.67	27.75	....	...	7.82	234	....								
Station 89: March 23, 1929; 17°09' S, 152°41' W; depth bottom, 4286 m; weather, b; sea, S; wind, 0; good conditions																	
	0	28.38	35.64	22.77	....	...	8.25	21	....	0	28.38	35.64	22.77	22.77	0.0000	0.0000	0.00510
	5	28.36	35.64	22.78	....	...	8.25	17	....	5	28.36	35.64	22.78	22.80	0.0268	0.0255	509
	24	28.38	35.63	22.76	....	...	8.27	13	....	25	28.38	35.63	22.76	22.87	0.1341	0.1276	512
	47	28.53	35.80	22.84	....	...	8.27	12	....	50	28.55	35.84	22.86	23.09	0.2674	0.2543	502
h	71	28.03	36.01	23.17	....	...	8.24	12	....	75	27.90	36.02	23.21	23.55	0.3953	0.3761	471
9.0	94	26.70	36.02	23.60	....	...	8.24	12	....	100	26.45	36.02	23.68	24.13	0.513	0.488	427
5°	189	22.16	35.96	24.92	....	...	8.15	38	....	150	23.95	36.00	24.44	25.11	0.719	0.683	355
	283	18.14	35.45	25.60	....	...	8.10	46	....	200	21.65	35.94	25.05	25.95	0.892	0.848	299
	376	12.62	34.76	26.30	....	...	7.95	90	....	250	19.50	35.73	25.46	26.59	1.040	0.987	261
	471	9.34	34.53	26.72	....	...	7.84	186	....	300	17.20	35.29	25.70	27.07	1.172	1.112	239
	660	5.85	34.37	27.10	....	...	7.82	225	....	400	11.50	34.68	26.45	28.31	1.387	1.317	169
										500	8.65	34.49	26.79	29.14	1.549	1.469	136
	663	5.87	34.36	27.08	....	...	7.79	241	....	700	5.50	34.37	27.14	30.47	1.800	1.709	104
	945	4.11	34.46	27.37	....	....	7.75	249	....	1000	3.90	34.47	27.40	32.17	2.08	1.98	078
h	1416	2.88	34.56	27.57	....	...	7.76	245	....	1500	2.70	34.57	27.59	34.77	2.45	2.34	061
10.3	1884	2.30	34.58	27.63	....	...	7.76	248	....	2000	2.20	34.59	27.65	37.19	2.76	2.64	058
7°	2323	1.99	34.60	27.67	....	...	7.76	237	....	2500	1.90	34.61	27.69	39.58	3.04	2.91	055
	2770	1.79	34.62	27.71	....	...	7.76	237	....	3000	1.70	34.62	27.71	41.94	3.31	3.19	0.00053
	3192	1.64	34.62	27.71	....	...	7.79	237	....								

a) Piano wire. b) Thermometer did not function properly. c) Temperature from pressure thermometer and wire-depth.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire-angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 90: March 25, 1929; 16°35' S, 155°45' W; depth bottom, 4630 m; weather, bc; sea, MC; wind, E 4; stiff trade-wind																	
	3	28.50	35.49	22.62	....	...	8.27	21	....	0	28.50	35.49	22.62	22.62	0.0000	0.0000	0.00524
	8	28.48	35.50	22.64	....	...	8.27	21	....	5	28.50	35.50	22.63	22.65	0.0275	0.0262	523
	25	28.46	35.49	22.63	....	...	8.26	21	....	25	28.46	35.49	22.63	22.74	0.1376	0.1309	524
	49	28.60	35.62	22.68	....	...	8.26	21	....	50	28.60	35.62	22.68	22.91	0.2748	0.2613	519
h	70	..... a)	35.74	......	....	...	8.26	21	....	75	27.50	35.76	23.15	23.49	0.4057	0.3859	477
9.7	96	26.55	35.82	23.50	....	...	8.24	21	....	100	26.30	35.83	23.58	24.03	0.525	0.500	436
20°	190	22.66	35.96	24.78	....	...	8.15	44	....	150	24.20	35.94	24.31	24.98	0.737	0.701	368
	236	20.74	35.78	25.17	....	...	8.13	60	....	200	22.25	35.93	24.87	25.77	0.918	0.872	316
	283	18.03	35.40	25.59	....	...	8.07	78	....	250	19.85	35.69	25.35	26.48	1.073	1.019	272
	330	15.65	35.11	25.93	....	...	8.05	107	....	300	17.10	35.29	25.73	27.10	1.208	1.146	236
	378	13.25 b)	34.85	26.24	....	...	7.98	127	....	400	11.85	34.73	26.42	28.28	1.423	1.351	172
										500	8.35	34.41	26.78	29.13	1.586	1.505	137
	412	11.01	34.63	26.50	....	...	7.92	166	....	700	5.45	34.36	27.13	30.46	1.839	1.747	105
	503	8.22	34.41	26.80	....	...	7.87	205	....	1000	4.10	34.49	27.39	32.16	2.13	2.03	080
h	687	5.58	34.36	27.12	....	...	7.82	237	....	1500	2.80	34.53	27.54	34.72	2.51	2.40	066
8.9	963	4.23	34.52	27.40	....	...	7.88	201	....	2000	2.15	34.56	27.63	37.18	2.83	2.71	059
27°	1431	2.91	34.48	27.50	....	...	7.79	265	....	2500	1.90	34.57	27.66	39.55	3.12	3.00	0.00058
	1880	2.27	34.57	27.63	....	...	7.80	257	....								
	2295	2.03	34.56	27.63	....	...	7.80	261	....								
Station 91: March 27, 1929; 15°44' S, 160°25' W; depth bottom, 4937 m; weather, bc; sea, MCL; wind, ENE 4; stiff trade-wind																	
	0	28.71	35.13	22.28	....	...	8.30	21	....	0	28.71	35.13	22.28	22.28	0.0000	0.0000	0.00557
	4	28.70	35.15	22.30	....	...	8.30	21	....	5	28.70	35.15	22.30	22.32	0.0292	0.0279	555
	20	28.65	35.17	22.33	....	...	8.30	24	....	25	28.65	35.17	22.33	22.44	0.1456	0.1386	553
	42	28.65	35.13	22.30	....	...	8.30	24	....	50	28.50	35.25	22.44	22.67	0.2895	0.2755	542
h	66	27.40	35.76	23.18	....	...	8.30	24	....	75	26.90	35.87	23.43	23.77	0.4199	0.3996	450
10.5	86	26.26	35.92	23.67	....	...	8.30	24	....	100	25.75	35.96	23.86	24.31	0.533	0.507	410
32°	173	23.01	36.01	24.71	....	...	8.21	46	....	150	23.85	36.00	24.46	25.13	0.734	0.698	354
	261	19.34	35.59	25.40	....	...	8.19	64	....	200	22.15	35.99	24.95	25.85	0.909	0.864	309
	349	14.46	35.00	26.11	....	...	8.05	127	....	250	19.95	35.69	25.32	26.45	1.063	1.009	274
	439	9.80	34.57	26.67	....	...	7.93	200	....	300	17.40	35.30	25.67	27.04	1.199	1.139	242
	615	..... a)	34.38	.....	....	...	7.86	245	....	400	11.50	34.73	26.49	28.35	1.414	1.343	165
										500	8.15	34.45	26.84	29.19	1.571	1.491	131
	937	4.19	34.51	27.40	....	...	7.82	272	....	700	5.45	34.41	27.17	30.50	1.814	1.722	100
	1390	3.01	34.56	27.56	....	...	7.82	281	....	1000	3.95	34.52	27.43	32.20	2.09	1.98	075
h	1844	2.34	34.63	27.67	....	...	7.82	281	....	1500	2.85	34.57	27.58	34.75	2.45	2.33	062
9.3	2269	1.87	34.60	27.68	....	...	7.82	297	....	2000	2.15	34.62	27.68	37.22	2.76	2.63	055
27°	2701	1.81	34.48 c)	27.59	....	...	7.83	281	....	2500	1.80	34.62	27.71	39.61	3.02	2.89	052
	3102	1.68	34.64	27.72	....	...	7.83	272	....	3000	1.70	34.64	27.72	41.95	3.28	3.16	052
	3504	1.58	34.66	27.75	....	...	7.84	265	....	3500	1.60	34.65	27.74	44.26	3.54	3.42	0.00052
	3863	1.47	34.65	27.75	....	...	7.84	253	....								
Station 92: March 29, 1929; 15°18' S, 163°14' W; depth bottom, 5530 m; weather, b; sea, S; wind, 0; good conditions																	
	0	28.52	35.32	22.49	....	...	8.29	28	....	0	28.52	35.32	22.49	22.49	0.0000	0.0000	0.00537
h	5	28.43	35.30	22.50	....	...	8.29	28	....	5	28.43	35.30	22.50	22.52	0.0282	0.0269	536
10.3	23	28.42	35.34	22.53	....	...	8.29	28	....	25	28.40	35.34	22.54	22.65	0.1405	0.1338	533
8°	47	28.43	35.41	22.58	....	...	8.29	28	....	50	28.40	35.44	22.61	22.84	0.2797	0.2661	526
	70	27.48 b)	35.77	23.17	....	...	8.29	28	....	75	27.30	35.82	23.26	23.60	0.4100	0.3902	466
	94	26.38	35.95	23.65	....	...	8.28	28	....	100	26.20	35.96	23.71	24.16	0.527	0.501	0.00424

a) Thermometer did not function properly. b) Temperature from pressure-thermometer and wire-depth. c) Salinity regarded as erroneous.

Table 2--Physical and chemical data and results of dynamic computations for <u>Carnegie</u> deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 92--Continued																	
	189	22.29	35.95	24.87	....	...	8.20	52	....	150	24.05	36.00	24.40	25.07	0.733	0.697	0.00359
h	281	17.31	35.35	25.73	....	...	8.10	90	....	200	21.70	35.91	25.01	25.91	0.908	0.863	303
10.3	372	12.13	34.76	26.40	....	...	7.97	200	....	250	19.00	35.60	25.50	26.63	1.056	1.002	257
8°	470	8.37	34.51	26.85	....	...	7.87	249	....	300	16.30	35.20	25.85	27.22	1.184	1.123	225
	657	5.62	34.40	27.15	....	...	7.82	265	....	400	10.85	34.66	26.56	28.43	1.385	1.316	159
										500	7.70	34.47	26.92	29.28	1.534	1.456	122
	663	5.61	34.44	27.18	....	...	7.81	272	....	700	5.35	34.43	27.20	30.53	1.765	1.675	097
	948	4.02	34.50	27.41	....	...	7.76	285	....	1000	3.85	34.51	27.43	32.20	2.04	1.93	075
h	1423	2.90	34.56	27.57	....	...	7.78	330	....	1500	2.75	34.57	27.58	34.76	2.40	2.28	062
9.1	1892	2.23	34.63	27.68	....	...	7.78	285	....	2000	2.15	34.63	27.68	37.22	2.70	2.58	055
8°	2330	1.98	34.63	27.70	....	...	7.78	292	....	2500	1.90	34.63	27.70	39.59	2.97	2.84	054
	2774	1.80	34.63	27.71	....	...	7.79	292	....	3000	1.70	34.65	27.73	41.96	3.23	3.11	0.00051
	3194	1.67	34.67	27.75	....	...	7.79	292	....								
Station 93: March 31, 1929; 14°41' S, 167°41' W; depth bottom, 5208 m; weather, bcqr; sea, S; wind, 0 to NE 2; good conditions																	
	0	28.74	34.71	21.95	....	...	8.30	28	....	0	28.74	34.71	21.95	21.95	0.0000	0.0000	0.00588
	5	28.75	34.68	21.92	....	...	8.30	28	....	5	28.75	34.68	21.92	21.95	0.0309	0.0295	591
	23	28.74	34.76	21.99	....	...	8.30	28	....	25	28.75	34.76	21.99	22.10	0.1545	0.1471	585
	47	28.57[a]	34.78	22.06	....	...	8.30	28	....	50	28.50	34.78	22.08	22.31	0.3071	0.2923	577
h	70	.....	35.12	.....	....	...	8.28	28	....	75	28.05	35.40	22.70	23.04	0.4512	0.4294	519
9.5	94	27.65	35.83	23.16	....	...	8.27	29	....	100	27.55	35.85	23.20	23.65	0.581	0.553	473
5°	188	23.25	36.07	24.69	....	...	8.21	50	....	150	25.90	36.03	23.86	24.53	0.814	0.774	411
	235	21.07	35.84	25.13	....	...	8.11	62	....	200	22.65	36.04	24.84	25.73	1.007	0.957	319
	283	18.04	35.47	25.64	....	...	8.10	96	....	250	20.25	35.76	25.29	26.42	1.164	1.106	277
	329	14.74	35.04	26.07	....	...	8.02	127	....	300	16.90	35.28	25.77	27.13	1.300	1.233	233
	377	12.53	34.77	26.32	....	...	7.97	178	....	400	11.70	34.75	26.47	28.33	1.511	1.434	167
										500	8.90	34.57	26.82	29.17	1.670	1.584	133
	383	12.79	34.83	26.32	....	...	7.98	154	....	700	5.65	34.38	27.12	30.44	1.921	1.823	106
	478	9.47	34.61	26.75	....	...	7.84	220	....	1000	3.95	34.47	27.39	32.16	2.21	2.10	080
h	668	5.98	34.38	27.09	....	...	7.81	253	....	1500	2.70	34.52	27.55	34.73	2.59	2.47	065
8.8	955	4.12	34.46	27.37	....	...	7.77	292	....	2000	2.15	34.57	27.64	37.18	2.91	2.78	058
6°	1433	2.85	34.52	27.54	....	...	7.76	303	....	2500	1.90	34.63	27.70	39.59	3.19	3.06	0.00054
	1900	2.23	34.53	27.60	....	...	7.78	292	....								
	2335	1.99	34.61	27.68	....	...	7.78	292	....								
Station 94: April 22, 1929; 12°47' S, 171°35' W; depth bottom, 4760 m; weather, bcqr; sea, MC; wind, E 3; fairly good conditions																	
	0	29.48	34.73[b]	21.72	....	...	8.25	14	....	0	29.48	34.73	21.72	21.72	0.0000	0.0000	0.00610
	5	29.48	.....	.....	....	...	8.25	14	....	5	29.48	34.73	21.72	21.75	0.0320	0.0305	610
	24	29.44	34.72	21.72	....	...	8.24	14	....	25	29.45	34.72	21.73	21.84	0.1601	0.1526	610
	47	29.35	34.72[b]	21.76	....	...	8.25	14	....	50	29.30	34.72	21.77	22.00	0.3199	0.3047	607
h	71	29.10	.....	.....	....	...	8.25	14	....	75	29.05	34.85	21.95	22.29	0.4772	0.4545	591
10.8	95	28.66	35.47	22.56	....	...	8.21	25	....	100	28.50	35.58	22.68	23.13	0.623	0.594	522
10°	190	23.09	36.12[b]	24.78	....	...	8.15	36	....	150	25.75	36.04	23.91	24.57	0.868	0.825	406
	235	20.52	.....	.....	....	...	8.10	50	....	200	22.45	36.11	24.95	25.84	1.057	1.005	309
	285	17.17	35.36	25.76	....	...	8.03	70	....	250	19.45	35.72	25.48	26.61	1.207	1.146	259
	379	11.57	34.76[b]	26.50	....	...	7.89	94	....	300	16.05	35.20	25.91	27.28	1.334	1.266	219
	478	8.10	.....	.....	....	...	7.80	154	....	400	10.55	34.70	26.64	28.51	1.528	1.451	0.00151

[a] Thermometer did not function properly. [b] One cell of salinity bridge out of order.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values					Computed values			
					Oxygen											Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 94--Continued																	
	470	8.15	34.57	26.94	....	...	7.81	146	....	500	7.60	34.54	26.99	29.35	1.669	1.585	0.00116
	661	5.85	34.45	27.16	....	...	7.76	166	....	700	5.60	34.45	27.19	30.51	1.895	1.800	099
h	947	4.51	34.48	27.34	....	...	7.74	190	....	1000	4.30	34.49	27.37	32.13	2.18	2.07	082
9.6	1428	2.96	34.54[a]	27.55	....	...	7.73	190	....	1500	2.80	34.55	27.56	34.73	2.57	2.44	064
25°	1902	2.29	.....[a]	.....	....	...	7.71	190	....	2000	2.20	34.59	27.65	37.19	2.89	2.75	058
	2339	1.98	.....[a]	.....	....	...	7.72	188	....	2500	1.90	34.63	27.70	39.59	3.16	3.03	0.00054
	2783	1.83	34.66	27.73	....	...	7.73	184	....								
Station 95: April 24, 1929; 8°43' S, 170°56' W; depth bottom, 4298[b] m; weather, bc; sea, MC; wind, E 4; fair conditions; strong surface current apparently about 100 meters deep																	
	0	29.43	34.70	21.70	....	...	8.26	14	....	0	29.43	34.70	21.71	21.71	0.0000	0.0000	0.00611
	4	29.41	34.68	21.70	....	...	8.26	16	....	5	29.40	34.68	21.71	21.74	0.0321	0.0306	611
	23	29.36	34.69	21.73	....	...	8.25	16	....	25	29.35	34.69	21.73	21.84	0.1603	0.1527	610
	46	29.34	34.91	21.90	....	...	8.24	16	....	50	29.30	34.92	21.92	22.15	0.3182	0.3029	592
h	70	29.21	35.03	22.04	....	...	8.24	16	....	75	29.15	35.08	22.09	22.43	0.4718	0.4493	578
10.6	93	28.74	35.35	22.43	....	...	8.22	21	....	100	28.50	35.44	22.58	23.03	0.617	0.588	532
40°	185	23.16	36.06	24.71	....	...	8.11	48	....	150	25.95	35.94	23.78	24.44	0.867	0.825	418
	278	15.57	35.14	25.97	....	...	7.95	78	....	200	21.90	36.03	25.04	25.93	1.058	1.005	300
	372	10.92	34.72	26.59	....	...	7.81	174	....	250	17.50	35.46	25.76	26.90	1.198	1.138	232
	467	8.22	34.61	26.95	....	...	7.80	178	....	300	14.30	34.96	26.11	27.48	1.313	1.246	200
	655	.....[c]	34.49	.....	....	...	7.76	190	....	400	9.90	34.68	26.73	28.60	1.493	1.417	141
										500	7.65	34.58	27.01	29.37	1.628	1.545	114
	777	5.53	34.45	27.20	....	...	7.75	182	....	700	5.95	34.47	27.16	30.47	1.856	1.761	102
	1015	4.42	34.47	27.34	....	...	7.73	205	....	1000	4.45	34.47	27.34	32.10	2.15	2.04	086
h	1412	3.21	34.53	27.51	....	...	7.72	213	....	1500	3.00	34.54	27.54	34.71	2.55	2.43	067
9.2	1806	2.36	34.59	27.64	....	...	7.74	198	....	2000	2.20	34.59	27.65	37.19	2.87	2.75	057
43°	2155	2.26	34.59	27.65	....	...	7.75	198	....	2500	1.85	34.62	27.70	39.59	3.15	3.02	0.00054
	2519	1.84	34.63	27.71	....	...	7.75	198	....								
	2842	1.74	34.60	27.69	....	...	7.76	198	....								
Station 96: April 26, 1929; 6°47' S, 172°23' W; depth bottom, 5269 m; weather, bc; sea, S; wind, 0; good conditions, vessel becalmed																	
	0	29.30[d]	35.27	22.19	....	...	8.23	12	....	0	29.30	35.27	22.19	22.19	0.0000	0.0000	0.00565
	6	29.25	35.27	22.21	....	...	8.24	12	....	5	29.25	35.27	22.21	22.23	0.0297	0.0282	562
	24	29.23	35.27	22.22	....	...	8.24	12	....	25	29.20	35.27	22.22	22.33	0.1481	0.1407	563
	47	29.21	35.28	22.22	....	...	8.23	12	....	50	29.20	35.28	22.22	22.45	0.2961	0.2815	563
h	71	28.79[e]	35.49	22.52	....	...	8.21	13	....	75	28.75	35.51	22.55	22.89	0.4402	0.4187	534
10.4	94	28.41	35.63	22.75	....	...	8.19	25	....	100	28.25	35.67	22.84	23.29	0.577	0.549	507
9°	189	23.59	36.04	24.56	....	...	8.12	50	....	150	26.45	35.94	23.62	24.28	0.824	0.783	433
	237	18.74	35.52	25.50	....	...	8.02	66	....	200	22.50	36.03	24.87	25.76	1.023	0.971	316
	284	13.99	34.97	26.18	....	...	7.88	106	....	250	17.25	35.34	25.73	26.87	1.169	1.108	234
	377	9.08	34.63	26.84	....	...	7.77	172	....	300	12.55	34.87	26.40	27.78	1.276	1.210	172
	473	7.65[e]	34.56	27.00	....	...	7.77	182	....	400	8.60	34.60	26.89	28.77	1.433	1.359	0.00125

[a] One cell of salinity bridge out of order. [b] Sonic depths 4298 m at 8°51' S, 170°54' W and 4473 m at 8°27' S, 171°12' W. [c] Thermometer did not function properly. [d] Temperature mean of 29.°26 and 29.°34. [e] Temperature from pressure thermometer and wire depth.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 96--Continued																	
	477	7.80[a]	34.54	26.96	....	...	7.76	186	....	500	7.35	34.53	27.02	29.38	1.559	1.478	0.00113
	667	5.88	34.48	27.18	....	...	7.73	217	....	700	5.65	34.48	27.20	30.52	1.781	1.689	098
h	954	4.42	34.48	27.35	....	...	7.70	237	....	1000	4.25	34.48	27.36	32.12	2.07	1.96	083
9.2	1430	3.00	34.52	27.53	....	...	7.71	229	....	1500	2.85	34.53	27.54	34.71	2.46	2.34	067
10°	1899	2.37	34.57	27.62	....	...	7.71	228	....	2000	2.25	34.58	27.63	37.17	2.79	2.66	059
	2332	2.03	34.59	27.66	....	...	7.72	228	....	2500	1.95	34.60	27.68	39.57	3.07	2.94	0.00056
	2769	1.80	34.61	27.70	....	...	7.73	221	....								
Station 97: April 28, 1929; 3°47' S, 172°39' W; depth bottom, 5253 m; weather, bc; sea, ML; wind, NE 1-2; good conditions																	
	0	28.32	35.19[b]	22.45	....	...	8.16	24	....	0	28.32	35.19	22.45	22.45	0.0000	0.0000	0.00540
	5	28.32	35.19	22.45	....	...	8.16	21	....	5	28.32	35.19	22.45	22.47	0.0284	0.0270	539
	23	28.13	.....	.....	....	...	8.16	21	....	25	28.15	35.26	22.56	22.67	0.1410	0.1340	531
	46	28.05	35.35	22.66	....	...	8.16	21	....	50	28.00	35.35	22.68	22.91	0.2791	0.2653	519
h	71	27.90	35.35	22.71	....	...	8.15	24	....	75	27.85	35.36	22.73	23.07	0.4152	0.3947	516
11.4	93	27.68	35.55	22.93	....	...	8.15	25	....	100	27.60	35.59	22.99	23.44	0.547	0.521	493
22°	189	21.71	35.82	24.94	....	...	8.07	50	....	150	25.65	35.76	23.74	24.41	0.788	0.749	422
	238	14.38	35.07	26.18	....	...	7.86	110	....	200	20.10	35.81	25.37	26.27	0.971	0.923	270
	286	11.43[a]	34.85	26.60	....	...	7.81	146	....	250	13.40	34.99	26.32	27.48	1.088	1.034	177
	380	9.04	.....	.....	....	...	7.76	166	....	300	11.00	34.82	26.66	28.06	1.174	1.115	147
	477	7.99	.....	.....	....	...	7.73	186	....	400	8.65	34.68	26.94	28.82	1.314	1.249	120
	515	6.69	.....	.....	....	...	7.69	217	....	500	7.25	34.61	27.10	29.46	1.434	1.362	106
										700	5.75	34.51	27.22	30.54	1.646	1.564	096
	394	8.78	.....	.....	....	...	7.74	176	....	1000	4.35	34.51	27.38	32.14	1.92	1.83	081
h	887	4.78	34.50	27.32	....	...	7.68	232	....	1500	2.95	34.58	27.57	34.74	2.30	2.20	064
10.1	1300	3.41	.....	.....	....	...	7.68	233	....	2000	2.20	34.64	27.69	37.23	2.61	2.50	054
42°	1732	2.55	.....	.....	....	...	7.69	228	....	2500	1.85	34.67	27.74	39.63	2.87	2.75	0.00050
	2151	2.10	34.67	27.72	....	...	7.72	228	....								
	2595	1.83	34.65	27.73	....	...	7.73	221	....								
Station 98: April 30, 1929; 0°18' N, 173°59' W; depth bottom, 5599 m; weather, bc; sea, MCL; wind, NE 4; vessel drifting; strong trade wind; observations at 1500-meter level omitted because water bottle probably reversed when being lowered																	
	1	27.05	35.24	22.90	....	...	8.16	24	....	0	27.05	35.27	22.93	22.93	0.0000	0.0000	0.00494
	4	27.04	35.30	22.95	....	...	8.15	24	....	5	27.05	35.27	22.93	22.95	0.0260	0.0247	493
	19	26.98	35.25	22.93	....	...	8.16	25	....	25	26.95	35.27	22.96	23.07	0.1298	0.1233	493
	38	26.91	35.30	23.00	....	...	8.16	25	....	50	26.90	35.30	23.00	23.23	0.2589	0.2461	489
h	57	26.89	35.26	22.97	....	...	8.16	28	....	75	26.75	35.38	23.10	23.44	0.3864	0.3674	481
11.0	75	26.76	35.38	23.10	....	...	8.14	28	....	100	26.70	35.40	23.13	23.58	0.512	0.487	479
45°	151	26.51	35.43	23.22	....	...	8.14	42	....	150	26.60	35.43	23.19	23.86	0.763	0.725	475
	188	24.98	35.52	23.76	....	...	8.11	56	....	200	24.10	35.46	23.98	24.87	0.995	0.945	402
	226	21.01	35.20	24.67	....	...	8.05	78	....	250	17.20	35.09	25.55	26.69	1.167	1.108	251
	301	12.50	34.92	26.45	....	...	7.93	114	....	300	12.60	34.93	26.43	27.82	1.278	1.213	169
										400	9.45	34.68	26.81	28.68	1.437	1.365	134
h	398	9.57	34.68	26.79	....	...	7.74	200	....	500	8.05	34.63	26.99	29.34	1.570	1.490	116
9.0	501	8.05	34.63	26.99	....	...	7.73	217	....	700	6.20	34.57	27.21	30.52	1.796	1.704	098
38°	704	6.17	34.57	27.22	....	...	7.71	249	....	1000	4.45	34.51	27.37	32.13	2.08	1.98	082
	1016	4.41	34.51	27.38	....	...	7.70	281	....	1500	3.05	34.58	27.56	34.72	2.47	2.35	065
h										2000	2.25	34.63	27.67	37.21	2.78	2.66	056
9.8	1959	2.32	34.63	27.67	....	...	7.71	277	....	2500	1.90	34.65	27.72	39.61	3.05	2.92	0.00052
45°	2430	1.96	34.65	27.71	....	...	7.72	277	....								

a) Temperature from pressure-thermometer and wire depth. b) All salinities by titration because salinity-bridge out of order.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

	Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 99: May 2, 1929; 4°22' N, 176°23' W; depth bottom, 4951 m; weather, bcqr; sea, CL; wind, NE by E 4; poor conditions; rolling, chopping sea; vessel surging heavily																	
	0	27.93	34.94	22.39	....	...	8.21	12	....	0	27.93	34.93	22.39	22.39	0.0000	0.0000	0.00546
	5	27.93	34.93	22.38	....	...	8.21	12	....	5	27.93	34.93	22.38	22.41	0.0287	0.0274	547
	23	27.83	34.93	22.42	....	...	8.22	12	....	25	27.85	34.93	22.41	22.52	0.1434	0.1366	545
	47	27.83	34.94	22.43	....	...	8.22	12	....	50	27.85	34.94	22.42	22.65	0.2866	0.2727	544
h	71	27.82	34.97	22.46	....	...	8.22	12	....	75	27.80	34.98	22.46	22.80	0.4294	0.4086	543
13.9	96	27.84	35.04	22.50	....	...	8.22	17	....	100	27.80	35.04	22.51	22.96	0.571	0.544	539
17°	145	24.16	34.96	23.58	....	...	8.14	36	....	150	23.60	34.95	23.74	24.41	0.824	0.784	422
	194	15.68	34.67	25.58	....	...	7.96	122	....	200	15.00	34.65	25.72	26.64	0.997	0.948	234
	242	10.51	34.63	26.59	....	...	7.77	188	....	250	10.25	34.63	26.64	27.81	1.097	1.043	146
	291	9.34	34.66	26.81	....	...	7.75	205	....	300	9.25	34.66	26.83	28.23	1.170	1.112	129
	390	8.45	34.64	26.94	....	...	7.71	224	....	400	8.30	34.63	26.95	28.83	1.301	1.237	120
										500	7.65	34.59	27.02	29.38	1.425	1.353	113
	392	8.42	34.63	26.94	....	...	....	...	....	700	6.05	34.55	27.21	30.52	1.647	1.563	097
h	492	7.74	34.59	27.01	....	...	....	...	....	1000	4.45	34.54	27.39	32.15	1.93	1.83	080
14.6	687	6.10	34.56	27.21	....	...	....	...	....	1500	3.00	34.60	27.59	34.76	2.30	2.19	062
19°	983	4.57	34.54	27.38	....	...	7.68	277	....	2000	2.25	34.64	27.68	37.22	2.60	2.49	0.00055
	1468	3.09	34.59	27.57	....	...	7.69	277	....								
	1937	2.32	34.64	27.68	....	...	7.71	272	....								
h	397	8.36	.....	.....	....	...	7.70	224	....								
12.7	498	7.65	.....	.....	....	...	7.68	245	....								
23°	701	6.10	.....	.....	....	...	7.68	281	....								
Station 100: May 4, 1929; 8°05' N, 178°48' W; depth bottom, 5800 m; weather, bc; sea, ML; wind, E 3; fair conditions																	
	0	27.73	34.72	22.29	....	...	8.21	10	....	0	27.73	34.72	22.29	22.29	0.0000	0.0000	0.00556
	5	27.72	34.73	22.29	....	...	8.22	10	....	5	27.72	34.73	22.29	22.32	0.0292	0.0279	556
	23	27.67	34.72	22.31	....	...	8.22	10	....	25	27.65	34.72	22.32	22.43	0.1457	0.1388	554
	47	27.67[a]	34.71	22.31	....	...	8.21	10	....	50	27.65	34.71	22.31	22.54	0.2913	0.2775	555
h	70	.....	34.70	.....	....	...	8.22	10	....	75	27.65	34.70	22.30	22.64	0.4375	0.4167	558
10.2	94	27.62	34.70	22.31	....	...	8.22	12	....	100	27.60	34.70	22.32	22.77	0.583	0.556	557
15°	188	12.22	34.47	26.15	....	...	7.78	174	....	150	18.15	34.64	24.98	25.66	0.810	0.771	303
	235	10.62	34.65	26.58	....	...	7.70	196	....	200	11.65	34.48	26.26	27.19	0.938	0.893	182
	283	9.94	34.66	26.72	....	...	7.70	213	....	250	10.35	34.66	26.65	27.82	1.024	0.974	145
	379	9.13	34.63	26.83	....	...	7.69	224	....	300	9.75	34.65	26.74	28.14	1.099	1.045	138
	474	8.35	34.60	26.93	....	...	7.69	228	....	400	8.95	34.62	26.85	28.72	1.240	1.179	129
										500	8.05	34.59	26.96	29.31	1.373	1.303	119
	489	8.19	34.59	26.94	....	...	7.67	232	....	700	6.40	34.52	27.15	30.46	1.608	1.526	104
	684	6.48	34.52	27.14	....	...	7.65	257	....	1000	4.70	34.53	27.35	32.10	1.90	1.81	085
	1175	3.91	34.56	27.47	....	...	7.67	264	....	1500	3.05	34.60	27.58	34.74	2.29	2.19	063
9.0	1736	2.64	34.59	27.61	....	...	7.69	268	....	2000	2.25	34.63	27.67	37.21	2.61	2.49	056
18°	1939	2.32	34.63	27.67	....	...	7.70	268	....	2500	1.90	34.64	27.71	39.60	2.87	2.75	0.00053
	2376	1.99	34.65	27.71	....	...	7.73	268	....								
	2825	1.79	34.63	27.71	....	...	7.74	264	....								
Station 101: May 7, 1929; 13°23' N, 177°27' E; depth bottom, 5663 m; weather, bc; sea, CL; wind, NE by E 5; fair conditions; heavy westerly drift																	
h	0	26.30	34.71	22.74	....	...	8.24	8	....	0	26.30	34.71	22.74	22.74	0.0000	0.0000	0.00512
10.4	5	26.30	34.70	22.73	....	...	8.24	8	....	5	26.30	34.70	22.73	22.76	0.0269	0.0257	513
35°	28	26.24	34.68	22.74	....	...	8.23	8	....	25	26.25	34.68	22.73	22.84	0.1349	0.1284	514
	52	26.24	34.72	22.77	....	...	8.24	8	....	50	26.25	34.72	22.77	23.00	0.2697	0.2565	0.00511

[a] Thermometer did not function properly.

Table 2--Physical and chemical data and results of dynamic computations for <u>Carnegie</u> deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 101--Continued																	
	80	25.59	34.94	23.13	....	...	8.24	8	....	75	25.75	34.87	23.04	23.38	0.4009	0.3813	0.00487
h	106	25.12	35.10	23.40	....	...	8.23	8	....	100	25.25	35.06	23.33	23.78	0.525	0.500	460
10.4	161	23.66	35.12	23.85	....	...	8.24	9	....	150	24.00	35.12	23.76	24.43	0.757	0.719	420
35°	216	18.68	34.66	24.86	....	...	8.06	36	....	200	20.80	34.81	24.42	25.32	0.963	0.915	359
	329	10.42	34.23	26.30	....	...	7.81	158	....	250	14.00	34.43	25.76	26.92	1.118	1.062	232
	449	7.82	34.46	26.90	....	...	7.69	220	....	300	11.35	34.24	26.14	27.53	1.231	1.169	196
										400	8.75	34.36	26.68	28.56	1.410	1.340	145
	447	8.18	34.39	26.79	....	...	7.69	213	....	500	7.40	34.40	26.91	29.27	1.553	1.474	123
h	523	7.15	34.40	26.95	....	...	7.68	245	....	700	5.75	34.48	27.19	30.51	1.787	1.696	099
9.2	681	5.86	34.47	27.17	....	...	7.67	268	....	1000	4.40	34.49	27.36	32.12	2.07	1.97	0.00083
44°	964	4.55	34.49	27.34	....	...	7.66	264	....								
	1347	3.22	34.44	27.44	....	...	7.68	264	....								
Station 102: May 9, 1929; 16°25' N, 171°59' E; depth bottom, 5245 m; weather, bc; sea, ML; wind, ENE 4; fair conditions																	
	0	25.82	34.97	23.09	....	...	8.24	8	....	0	25.82	34.97	23.09	23.09	0.0000	0.0000	0.00479
	5	25.82	35.01	23.12	....	...	8.24	8	....	5	25.82	35.01	23.12	23.14	0.0251	0.0239	475
	21	25.82	35.00	23.11	....	...	8.24	8	....	25	25.80	34.99	23.11	23.22	0.1255	0.1192	478
	42	25.83	34.97	23.09	....	...	8.24	8	....	50	25.80	34.98	23.10	23.33	0.2515	0.2388	479
h	64	25.78[a]	35.00	23.13	....	...	8.23	8	....	75	25.75	35.00	23.13	23.47	0.3774	0.3585	478
8.7	84	25.73	35.00	23.14	....	...	8.23	8	....	100	25.60	35.02	23.20	23.65	0.502	0.477	473
35°	126	25.31	35.08	23.32	....	...	8.23	8	....	150	25.05	35.16	23.47	24.14	0.744	0.707	448
	170	24.72	35.24	23.63	....	...	8.23	8	....	200	23.75	35.20	23.89	24.78	0.971	0.923	411
	255	19.25	34.96	24.95	....	...	8.12	24	....	250	19.80	35.00	24.83	25.96	1.164	1.105	321
	338	12.58	34.34	25.98	....	...	7.91	96	....	300	15.10	34.65	25.70	27.07	1.312	1.245	239
	423	8.83	34.22	26.55	....	...	7.82	162	....	400	9.55	34.23	26.44	28.32	1.526	1.450	169
										500	7.30	34.26	26.82	29.18	1.685	1.600	132
	594	6.16	34.34	27.03	....	...	7.67	233	....	700	5.45	34.42	27.19	30.52	1.927	1.830	098
	825	4.84	34.49	27.31	....	...	7.67	245	....	1000	4.10	34.50	27.40	32.17	2.20	2.10	079
h	987	4.18	34.49	27.38	....	...	7.66	257	....	1500	2.70	34.56	27.58	34.76	2.57	2.45	062
9.8	1404	2.90	34.53	27.54	....	...	7.67	253	....	2000	2.10	34.65	27.70	37.25	2.87	2.74	052
47°	1679	2.45	34.63	27.66	....	...	7.70	253	....	2500	1.80	34.65	27.73	39.63	3.12	2.99	0.00050
	2223	1.92	34.65	27.72	....	...	7.72	253	....								
	2655	1.72	34.64	27.72	....	...	7.73	249	....								
Station 103: May 11, 1929; 19°19' N, 166°23' E; depth bottom, 3708 m; weather, bc; sea, MC; wind, ENE 4; fair conditions																	
	0	26.03	34.96	23.01	....	...	8.25	5	....	0	26.03	34.96	23.01	23.01	0.0000	0.0000	0.00487
	5	26.02	34.97	23.02	....	...	....	...	....	5	26.02	34.97	23.02	23.05	0.0255	0.0344	486
	24	25.93	34.91	23.01	....	...	....	...	....	25	25.95	34.91	23.00	23.11	0.1279	0.1219	489
	49	25.85	35.15	23.22	....	...	8.25	5	....	50	25.85	35.15	23.22	23.45	0.2537	0.2415	468
h	73	25.62	35.17	23.30	....	...	8.25	5	....	75	25.60	35.17	23.31	23.65	0.3759	0.3577	461
11.8	98	24.81	35.20	23.57	....	...	8.25	5	....	100	24.75	35.20	23.59	24.04	0.493	0.470	435
22°	148	23.26	35.27	24.08	....	...	8.21	7	....	150	23.20	35.27	24.10	24.77	0.710	0.675	388
	199	21.93	35.24	24.44	....	...	8.19	8	....	200	21.90	35.23	24.44	25.33	0.908	0.862	357
	299	16.46	34.63	25.38	....	...	8.12	21	....	250	19.95	34.85	24.68	25.81	1.090	1.035	336
	400	13.44	34.45	25.89	....	...	8.04	52	....	300	16.35	34.62	25.40	26.77	1.250	1.186	268
	502	9.32	34.19	26.45	....	...	7.88	130	....	400	13.45	34.45	25.89	27.74	1.508	1.432	224
										500	9.40	34.20	26.45	28.79	1.716	1.629	170
	472	10.44	34.24	26.30	....	...	7.92	120	....	700	5.70	34.22	27.00	30.32	2.017	1.916	117
h	662	6.03	34.19	26.93	....	...	7.69	213	....	1000	4.00	34.42	27.35	32.12	2.33	2.22	084
12.8	944	4.27	34.39	27.29	....	...	7.66	237	....	1500	2.65	34.58	27.60	34.78	2.71	2.58	0.00060
32°	1414[b]	2.82	34.57	27.58	....	...	7.70	233	....								
	1744[b]	3.65	35.12	.....	....	...	8.24	...	....								

[a] Temperature from pressure thermometer and wire depth. [b] Water-bottle probably reversed at wrong level; values rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 104: May 13, 1929; 20°12' N, 161°19' E; depth bottom, 4741[a] m; weather, b; sea, MC; wind, ENE 4; good conditions																	
	0	26.12	35.17	23.14	....	...	8.24	7	....	0	26.12	35.17	23.14	23.14	0.0000	0.0000	0.00474
	5	26.11	35.21	23.17	....	...	....	...	....	5	26.11	35.21	23.17	23.19	0.0249	0.0237	471
	23	25.97	35.24	23.25	....	...	....	...	....	25	25.95	35.24	23.25	23.36	0.1234	0.1173	465
	46	25.87[b]	35.22	23.26	....	...	....	...	....	50	25.85	35.22	23.27	23.50	0.2454	0.2333	463
h	69	.....	35.27	.....	....	...	8.24	7	....	75	25.70	35.29	23.36	23.70	0.3663	0.3484	457
10.0	93	25.45	35.32	23.46	....	...	8.21	7	....	100	25.30	35.32	23.52	23.97	0.484	0.460	442
25°	188	21.63	34.96	24.31	....	...	8.15	7	....	150	23.75	35.18	23.87	24.54	0.708	0.673	410
	237	17.84	34.71	25.11	....	...	8.11	16	....	200	20.70	34.88	24.50	25.40	0.910	0.864	352
	286	16.22	34.67	25.46	....	...	8.09	24	....	250	17.25	34.70	25.24	26.38	1.076	1.022	282
	385	13.66	34.40	25.81	....	...	8.03	40	....	300	15.85	34.62	25.51	26.88	1.219	1.158	257
	486	10.69	34.23	26.25	....	...	7.94	96	....	400	13.20	34.36	25.88	27.73	1.472	1.399	225
										500	10.00	34.20	26.35	28.69	1.685	1.601	179
	492	9.81	34.20	26.38	....	...	7.89	110	....	700	5.60	34.13	26.93	30.26	2.002	1.903	123
	690	5.63	34.12	26.92	....	...	7.70	220	....	1000	4.05	34.46	27.37	32.14	2.32	2.21	082
h	988	4.08	34.45	27.36	....	...	7.66	233	....	1500	2.65	34.58	27.60	34.78	2.69	2.57	060
8.8	1497	2.67	34.58	27.60	....	...	7.67	228	....	2000	2.00	34.60	27.67	37.22	2.99	2.86	055
27°	1856	2.14	34.51	27.59	....	...	7.70	217	....	2500	1.75	34.62	27.71	39.61	3.26	3.12	0.00052
	2433	1.77	34.61	27.70	....	...	7.72	217	....								
	2908	1.64	34.65	27.74	....	...	7.73	213	....								
Station 105: May 15, 1929; 18°43' N, 156°16' E; depth bottom, 5576 m; weather, bcqr; sea, MC; wind, ESE 3-4; fair conditions																	
	0	26.91	34.92	22.71	....	...	8.23	5	....	0	26.91	34.92	22.71	22.71	0.0000	0.0000	0.00515
	4	26.91	34.92	22.71	....	...	....	...	....	5	26.91	34.92	22.71	22.74	0.0271	0.0258	515
	23	26.84	34.91	22.73	....	...	....	...	....	25	26.85	34.91	22.72	22.83	0.1354	0.1288	515
	47	26.83	34.94	22.75	....	...	....	...	....	50	26.80	34.94	22.76	22.99	0.3704	0.2571	512
h	70	26.53	35.02	22.90	....	...	8.23	5	....	75	26.40	35.03	22.95	23.29	0.4028	0.3831	495
10.0	93	25.47	35.12	23.31	....	...	8.23	5	....	100	25.25	35.12	23.38	23.83	0.527	0.502	456
28°	188	21.46	35.15	24.50	....	...	8.15	11	....	150	23.25	35.15	24.00	24.67	0.752	0.715	397
	235	19.14	34.90	24.93	....	...	8.11	16	....	200	20.90	35.13	24.64	25.54	0.947	0.899	338
	282	16.96[c]	34.73	25.34	....	...	8.07	28	....	250	18.45	34.83	25.05	26.19	1.114	1.058	300
	376	.....	34.50	.....	....	...	8.02	44	....	300	16.20	34.69	25.48	26.85	1.262	1.199	260
	471	10.81	34.28	26.26	....	...	7.92	100	....	400	12.85	34.42	26.00	27.85	1.511	1.436	213
										500	9.85	34.24	26.40	28.74	1.716	1.630	175
	437	11.51	34.32	26.18	....	...	7.93	96	....	700	6.05	34.24	26.97	30.29	2.025	1.926	121
	617	7.22	34.19	26.77	....	...	7.71	204	....	1000	4.05	34.43	27.35	32.12	2.34	2.23	084
h	893	4.57	34.38	27.25	....	...	7.63	245	....	1500	2.70	34.56	27.58	34.76	2.72	2.60	062
8.9	1359	2.99	34.53	27.53	....	...	7.66	241	....	2000	2.05	34.61	27.68	37.23	3.03	2.90	054
39°	1693	2.37	34.60	27.64	....	...	7.68	233	....	2500	1.80	34.63	27.71	39.61	3.29	3.16	0.00052
	2237	1.90	34.63	27.70	....	...	7.70	233	....								
	2709	1.72	34.64	27.72	....	...	7.71	232	....								
Station 106: May 17, 1929; 16°14' N, 151°04' E; depth bottom, 5925 m; weather, bc; sea, ML; wind, ESE 5; fair conditions; strongest breeze so far at ocean station																	
	0	27.22	34.96	22.65	....	...	8.23	5	....	0	27.22	34.96	22.65	22.65	0.0000	0.0000	0.00521
	4	27.22	35.00	22.66	....	...	....	...	....	5	27.20	35.00	22.67	22.69	0.0273	0.0261	519
h	22	27.21	35.00	22.67	....	...	....	...	....	25	27.20	35.00	22.67	22.78	0.1367	0.1300	520
10.2	45	27.02	34.97	22.71	....	...	....	...	....	50	26.95	34.97	22.73	22.96	0.2727	0.2592	514
30°	67	26.41	35.01	22.93	....	...	8.23	5	....	75	26.20	35.03	23.01	23.35	0.4047	0.3848	490
	89	25.82	35.05	23.15	....	...	8.23	5	....	100	25.55	35.08	23.25	23.70	0.530	0.504	468
	137	24.26	35.19	23.72	....	...	8.20	5	....	150	23.75	35.19	23.88	24.55	0.761	0.723	0.00409

[a] Sonic Depths 4741 m at 20°12' N, 161°26' E and 1840 m at 20°13' N, 160°46' E. [b] Thermometer did not function properly. [c] Thermometer off scale.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 106--Continued																	
h	184	22.30	35.17	24.28	....	...	8.16	8	....	200	21.55	35.12	24.46	25.36	0.963	0.915	0.00356
10.2	277	17.81	34.70	25.11	....	...	8.09	20	....	250	19.10	34.88	24.92	26.05	1.139	1.082	312
30°	372	11.92	34.31	26.08	....	...	7.94	76	....	300	16.60	34.56	25.29	26.66	1.295	1.230	278
	468	9.23	34.30	26.55	....	...	7.79	182	....	400	11.00	34.30	26.25	28.12	1.540	1.464	189
										500	8.65	34.29	26.63	28.98	1.719	1.634	151
	466	9.56	34.30	26.50	....	...	7.79	176	....	700	5.95	34.35	27.07	30.39	1.994	1.897	112
	658	6.32	34.31	26.99	....	...	7.67	245	....	1000	4.35	34.49	27.36	32.12	2.30	2.19	083
h	950	4.52	34.48	27.34	....	...	7.67	257	....	1500	2.95	34.54	27.54	34.71	2.69	2.57	067
9.0	1446	3.08	34.54	27.53	....	...	7.69	249	....	2000	2.15	34.62	27.68	37.22	3.01	2.88	055
33°	1802	2.38	34.60	27.64	....	...	7.70	241	....	2500	1.80	34.63	27.71	39.61	3.27	3.15	0.00052
	2353	1.89	34.63	27.70	....	...	7.74	233	....								
	2832	1.72	34.63	27.71	....	...	7.74	232	....								
Station 107: May 19, 1929; 14°05' N, 146°06' E; depth bottom, 4920[a]m; weather, bc; sea, ML; wind, E by S 3-4; fair conditions; observations at 140-meter level omitted because water bottle probably reversed when being lowered																	
	0	28.03	34.42	21.97	....	...	8.23	5	....	0	28.03	34.42	21.97	21.97	0.0000	0.0000	0.00586
	4	28.01	34.45	22.00	....	...	....	...	....	5	28.00	34.45	22.00	22.02	0.0307	0.0293	583
	22	38.01	34.47	22.01	....	...	....	...	....	25	28.00	34.47	22.02	22.13	0.1532	0.1458	582
	46	27.99	34.39	21.95	....	...	....	...	....	50	27.95	34.39	21.97	22.20	0.3069	0.2919	587
h	69	27.60	34.49	22.16	....	...	8.23	4	....	75	27.45	34.55	22.26	22.60	0.4578	0.4356	562
10.1	92	26.92	34.82	22.63	....	...	8.23	11	....	100	26.75	34.88	22.73	23.18	0.599	0.570	517
30°	186	23.28	35.20	24.03	....	...	8.17	12	....	150	24.95	35.15	23.49	24.16	0.853	0.811	446
	283	14.99	34.56	25.65	....	...	8.02	48	....	200	22.45	35.19	24.26	25.16	1.070	1.017	375
	379	10.15	34.24	26.35	....	...	7.85	142	....	250	18.20	34.85	25.12	26.26	1.245	1.183	293
	482	7.60	34.33	26.82	....	...	7.68	237	....	300	13.85	34.45	25.81	27.19	1.383	1.314	229
										400	9.45	34.27	26.49	28.37	1.589	1.511	164
	479	7.64	34.37	26.85	....	...	7.72	233	....	500	7.30	34.36	26.89	29.25	1.742	1.656	125
	675	5.83	34.42	27.13	....	...	7.68	249	....	700	5.65	34.43	27.17	30.49	1.980	1.881	101
h	973	4.48	34.49	27.35	....	...	7.67	257	....	1000	4.40	34.49	27.36	32.12	2.27	2.16	083
8.9	1470	3.04	34.57	27.56	....	...	7.70	253	....	1500	2.95	34.57	27.57	34.74	2.65	2.53	064
32°	1821	2.41	34.54	27.59	....	...	7.71	245	....	2000	2.20	34.62	27.68	37.22	2.96	2.83	055
	2389	1.88	34.63	27.70	....	...	7.73	233	....	2500	1.80	34.63	27.71	39.61	3.23	3.09	0.00052
	2869	1.71	34.63	27.71	....	...	7.73	228	....								
Station 108: May 27, 1929; 18°26' N, 144°01' E; depth bottom, 3573 m; weather, bc; sea, MC; wind, E 4; fair conditions																	
	0	28.42	35.00	22.27	....	...	8.25	4	....	0	28.42	35.00	22.27	22.27	0.0000	0.0000	0.00558
	5	28.41[b]	34.95	22.24	....	...	....	...	....	5	28.41	34.95	22.24	22.26	0.0294	0.0280	560
	23	28.02	34.96	22.38	....	...	....	...	....	25	28.05	34.96	22.37	22.48	0.1460	0.1389	549
	46	26.96[c]	34.97	22.73	....	...	....	...	....	50	26.75	34.97	22.79	23.02	0.2850	0.2711	509
h	70	25.98	35.03	23.08	....	...	8.24	4	....	75	25.85	35.03	23.13	23.47	0.4148	0.3946	478
8.9	94	25.36	34.99	23.24	....	...	8.23	4	....	100	25.25	34.99	23.28	23.73	0.538	0.512	465
23°	187	22.55	35.03	24.11	....	...	8.17	4	....	150	23.95	35.02	23.69	24.36	0.773	0.735	427
	281	17.70	34.78	25.19	....	...	8.11	11	....	200	21.95	35.02	24.26	25.16	0.985	0.936	375
	377	14.45	34.53	25.74	....	...	8.03	40	....	250	19.35	34.87	24.85	25.98	1.168	1.109	319
	473	11.56	34.32	26.17	....	...	7.91	102	....	300	16.95	34.73	25.33	26.70	1.325	1.258	274
	666	6.79	34.27	26.89	....	...	7.72	196	....	400	13.75	34.46	25.84	27.69	1.589	1.510	0.00229

[a] Sonic depths 4920 m at 14°07' N, 146°14' E and 3736 m at 13°59' N, 145°45' E. [b] Temperature 28°.70 by second thermometer rejected.
[c] Temperature 26°.87 by second thermometer rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

		Observed values								Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 108--Continued																	
	649	7.06	34.26	26.84	....	...	7.72	194	....	500	10.70	34.29	26.29	28.62	1.808	1.717	0.00185
	933	4.61	34.44	27.29	....	...	7.67	237	....	700	6.30	34.30	26.98	30.29	2.129	2.022	120
h	1412	2.88	34.57	27.58	....	...	7.69	232	....	1000	4.30	34.47	27.36	32.12	2.45	2.33	083
10.0	1888	2.23	34.60	27.66	....	...	7.70	212	....	1500	2.70	34.58	27.59	34.77	2.83	2.69	061
30°	2335	1.88	34.63	27.70	....	...	7.71	200	....	2000	2.10	34.61	27.67	37.22	3.13	2.99	056
	2765	1.70	34.63	27.71	....	...	7.73	204	....	2500	1.80	34.62	27.71	39.61	3.39	3.25	052
	3189	1.68	34.64	27.72	....	...	7.74	200	....	3000	1.65	34.63	27.72	41.95	3.65	3.52	0.00052
Station 109: May 29, 1929; 23°22' N, 144°08' E; depth bottom, 5252 m; weather, bc; sea, MS; wind, ESE 3; fair conditions																	
	0	27.40	35.01	22.62	....	...	8.23	3	....	0	27.40	35.01	22.62	22.62	0.0000	0.0000	0.00524
	5	27.39	35.03	22.63	....	...	....	...	....	5	27.39	35.03	22.63	22.65	0.0275	0.0262	523
	23	27.13	35.02	22.72	....	...	....	...	....	25	27.10	35.02	22.72	22.83	0.1367	0.1300	515
	46	23.60[a]	34.95	23.74	....	...	....	...	....	50	23.10	34.95	23.88	24.11	0.2578	0.2450	405
h	70	21.60	34.95	24.31	....	...	8.22	3	....	75	21.00	34.94	24.47	24.81	0.3572	0.3395	350
9.1	93	19.81	34.86	24.72	....	...	8.18	5	....	100	19.45	34.84	24.80	25.25	0.445	0.423	319
24°	187	16.79	34.66	25.32	....	...	8.12	19	....	150	17.60	34.72	25.17	25.85	0.605	0.574	285
	283	15.17	34.60	25.65	....	...	8.08	36	....	200	16.45	34.65	25.39	26.30	0.751	0.712	266
	378	13.16	34.42	25.93	....	...	8.02	78	....	250	15.65	34.63	25.56	26.71	0.887	0.841	251
	474	10.69	34.19	26.21	....	...	7.94	110	....	300	14.90	34.57	25.68	27.05	1.017	0.964	241
	668	6.20	34.07	26.82	....	...	7.71	200	....	400	12.60	34.37	26.00	27.86	1.255	1.192	213
										500	10.10	34.15	26.29	28.63	1.465	1.391	186
	688	5.74	34.09	26.89	....	...	7.71	204	....	700	5.70	34.09	26.89	30.22	1.792	1.704	127
	989	4.04	34.29	27.24	....	...	7.62	281	....	1000	4.00	34.30	27.25	32.02	2.14	2.04	094
h	1491	2.51	34.48	27.53	....	...	7.65	277	....	1500	2.50	34.48	27.53	34.72	2.55	2.45	067
10.2	1976	2.00	34.61	27.68	....	...	7.70	268	....	2000	2.00	34.61	27.68	37.23	2.86	2.75	054
32°	2432	1.77	34.62	27.71	....	...	7.72	245	....	2500	1.75	34.62	27.71	39.61	3.12	3.01	052
	2902	1.61	34.63	27.72	....	...	7.74	237	....	3000	1.60	34.63	27.72	41.96	3.38	3.28	052
	3333	1.52	34.63	27.73	....	...	7.75	237	....	3500	1.50	34.63	27.73	44.26	3.64	3.54	0.00052
	3767	1.52	34.63	27.73	....	...	7.76	233	....								
Station 110: May 31, 1929; 26°20' N, 144°24' E; depth bottom, 3036 m; weather, b; sea, S; wind, S 2; good conditions; very little current																	
	0	23.86	34.71	23.48	....	...	8.18	5	....	0	23.86	34.71	23.48	23.48	0.0000	0.0000	0.00442
	5	24.06	34.71	23.43	....	...	....	...	....	5	24.06	34.71	23.43	23.45	0.0234	0.0223	447
	24	20.61	34.72	24.40	....	...	....	...	....	25	20.50	34.72	24.44	24.55	0.1074	0.1021	351
	48	18.47	34.76	24.99	....	...	....	...	....	50	18.35	34.76	25.02	25.25	0.1927	0.1828	295
h	72	18.07	34.76	25.08	....	...	8.16	7	....	75	18.05	34.76	25.10	25.44	0.2700	0.2559	289
8.8	96	17.96	34.73	25.10	....	...	8.14	11	....	100	17.90	34.73	25.11	25.56	0.346	0.328	289
10°	192	16.90	34.71	25.34	....	...	8.12	17	....	150	17.35	34.72	25.24	25.93	0.496	0.469	278
	287	16.51	34.69	25.41	....	...	8.11	28	....	200	16.85	34.71	25.35	26.26	0.641	0.607	270
	383	14.43	34.54	25.76	....	...	8.03	68	....	250	16.70	34.70	25.37	26.51	0.783	0.741	269
	480	12.17	34.36	26.08	....	...	7.95	88	....	300	16.25	34.68	25.46	26.83	0.923	0.874	262
	575	9.54	34.15	26.38	....	...	7.89	119	....	400	14.05	34.51	25.82	27.66	1.183	1.121	231
										500	11.60	34.32	26.16	28.48	1.410	1.336	199
	574	9.41	34.19	26.44	....	...	7.89	123	....	700	6.40	34.06	26.78	30.09	1.765	1.674	139
	668	7.03	34.05	26.69	....	...	7.79	186	....	1000	3.80	34.25	27.23	32.01	2.13	2.02	094
h	953	4.00	34.22	27.19	....	...	7.62	245	....	1500	2.45	34.48	27.54	34.73	2.55	2.43	065
9.6	1426	2.56	34.46	27.51	....	...	7.62	268	....	2000	1.95	34.56	27.64	37.20	2.86	2.74	057
10°	1892	2.02	34.53	27.61	....	...	7.67	245	....	2500	1.65	34.60	27.70	39.61	3.13	3.00	0.00052
	2331	1.75	34.59	27.68	....	...	7.68	241	....								
	2996[b]	1.49	.....	.....	....	...	....	...	....								

[a] Temperature 21.90 by second thermometer rejected. [b] Piano wire.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 111: June 3, 1929; 31°00' N, 144°16' E; depth bottom, 6008 m; weather, bcz; sea, MC; wind, W by N 3; good conditions																	
	0	20.08	34.52	24.39	....	...	8.18	5	....	0	20.08	34.52	24.39	24.39	0.0000	0.0000	0.00355
	5	20.60[b]	34.52	24.26	....	...	....	...	....	5	20.60	34.52	24.26	24.28	0.0190	0.0181	368
	24	19.73	34.57	24.52	....	...	....	...	....	25	19.75	34.57	24.52	24.63	0.0939	0.0893	344
	47	19.39	34.58	24.62	....	...	....	...	....	50	19.35	34.59	24.64	24.87	0.1830	0.1737	331
h	71	18.75	34.67	24.85	....	...	8.17	5	....	75	18.70	34.68	24.87	25.21	0.2679	0.2540	311
9.2	94	18.21	34.74	25.04	....	...	8.13	13	....	100	18.15	34.74	25.06	25.51	0.347	0.330	294
8°	187	16.86	34.71	25.35	....	...	8.11	19	....	150	17.45	34.75	25.23	25.92	0.499	0.472	279
	283	14.86	34.57	25.69	....	...	8.05	34	....	200	16.65	34.69	25.38	26.29	0.643	0.610	267
	377	12.02	34.41	26.14	....	...	7.97	92	....	250	15.60	34.62	25.56	26.71	0.779	0.739	251
	471	8.80	34.14	26.49	....	...	7.90	115	....	300	14.45	34.55	25.76	27.13	0.907	0.860	284
	565	6.26	33.97	26.73	....	...	7.80	155	....	400	11.15	34.36	26.27	28.14	1.128	1.071	186
										500	7.85	34.10	26.61	28.97	1.306	1.240	153
	483	8.42	34.15	26.56	....	...	7.87	111	....	700	5.15	34.08	26.95	30.29	1.592	1.514	121
	559	6.59	34.07	26.76	....	...	7.79	158	....	1000	3.55	34.32	27.31	32.10	1.91	1.83	086
	797	4.56	34.21	27.12	....	...	7.64	232	....	1500	2.45	34.47	27.53	34.72	2.31	2.21	066
h	1192	2.95	34.39	27.43	....	...	7.59	264	....	2000	1.90	34.56	27.65	37.21	2.63	2.52	057
10.2	1608	2.31	34.49	27.56	....	...	7.60	249	....	2500	1.70	34.62	27.71	39.61	2.89	2.79	0.00052
27°	2009	1.90	34.56	27.65	....	...	7.65	241	....								
	2424	1.72	34.63	27.71	....	...	7.68	237	....								
	5978[a]	1.49	.....	.....	....	...	....	...	....								
Station 112: June 5, 1929; 33°51' N, 141°15' E; depth bottom, 3931 m; weather, obc; sea, MC; wind, W by S 3; fair conditions; evidence of strong current																	
	0	23.25	34.60	23.58	....	...	8.22	7	....	0	23.25	34.60	23.58	23.58	0.0000	0.0000	0.00432
	5	23.23	34.56	23.56	....	...	....	...	....	5	23.23	34.56	23.55	23.57	0.0228	0.0217	435
	23	23.22	34.61	23.59	....	...	....	...	....	25	23.20	34.61	23.60	23.71	0.1140	0.1083	431
	46	21.71	34.60	24.02	....	...	....	...	....	50	21.70	34.60	24.02	24.25	0.2223	0.2109	390
h	61	21.67	34.63	24.04	....	...	8.23	7	....	75	20.90	34.67	24.29	24.63	0.3222	0.3056	367
9.0	92	20.16	34.71	24.52	....	...	8.20	8	....	100	19.85	34.71	24.60	25.05	0.415	0.394	338
15°	185	17.57	34.72	25.17	....	...	8.15	13	....	150	18.30	34.73	25.01	25.69	0.583	0.553	300
	278	16.39	34.65	25.40	....	...	8.10	24	....	200	17.35	34.71	25.23	26.14	0.738	0.699	281
	374	15.01	34.62	25.69	....	...	8.03	58	....	250	16.75	34.67	25.34	26.48	0.883	0.836	271
	470	12.96	34.39	25.95	....	...	7.99	82	....	300	16.05	34.64	25.48	26.85	1.024	0.969	260
										400	14.55	34.60	25.78	27.62	1.284	1.217	235
	465	12.63	34.45	26.06	....	...	7.97	86	....	500	11.60	34.36	26.19	28.51	1.512	1.433	196
	534	10.45	34.31	26.36	....	...	7.90	131	....	700	6.80	34.19	26.83	30.14	1.859	1.764	135
	600	8.68	34.22	26.58	....	...	7.83	166	....	1000	3.90	34.28	27.24	32.02	2.22	2.11	093
h	793	5.57	34.22	27.01	....	...	7.71	221	....	1500	2.55	34.45	27.50	34.68	2.64	2.52	070
10.0	1119	3.40	34.32	27.33	....	...	7.63	249	....	2000	1.95	34.60	27.68	37.24	2.96	2.84	054
42°	1475	2.58	34.41	27.47	....	...	7.62	264	....	2500	1.70	34.63	27.71	39.61	3.22	3.09	0.00052
	1821	2.13	34.59	27.65	....	...	7.63	253	....								
	3901[a]	1.41	.....	.....	....	...	....	...	....								
Station 113: June 25, 1929; 34°44' N, 141°04' E; depth bottom, 2911 m; weather, obc; sea, MC; wind, E 3; heavy current carried wire under vessel and necessitated putting her about on starboard tack and use of diving hood to clear piano wire from oscillator in keel; considerable delay but no loss of equipment																	
	0	24.19	34.53	23.25	....	...	8.25	5	....	0	24.19	34.53	23.25	23.25	0.0000	0.0000	0.00464
h	5	24.20	34.52	23.24	....	...	8.26	5	....	5	24.20	34.52	23.24	23.26	0.0244	0.0233	465
9.5	24	24.00	34.58	23.34	....	...	8.25	5	....	25	24.00	34.58	23.34	23.45	0.1213	0.1154	456
5°	48	23.77	34.59	23.42	....	...	8.25	5	....	50	23.75	34.59	23.43	23.66	0.2403	0.2283	448
	72	22.98	34.66	23.70	....	...	8.24	7	....	75	22.95	34.66	23.71	24.05	0.3548	0.3373	0.00423

[a] Piano wire. [b] Temperature mean of 20°.38 and 20°.81.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 113--Continued																	
	96	21.74	34.66	24.06	....	...	8.23	8	....	100	21.55	34.66	24.10	24.55	0.461	0.438	0.00386
	145	20.37	34.76	24.50	....	...	8.19	12	....	150	20.25	34.77	24.54	25.22	0.654	0.621	345
h	191	18.80	34.76	24.91	....	...	8.17	17	....	200	18.50	34.74	24.97	25.87	0.826	0.784	307
9.5	239	17.17	34.67	25.24	....	...	8.16	21	....	250	16.65	34.66	25.36	26.50	0.978	0.928	270
5°	286	14.91[a]	34.60	25.70	....	...	8.09	66	....	300	14.30	34.56	25.80	27.17	1.110	1.053	230
	383	.....	34.36	....	....	...	7.97	96	....	400	11.10	34.32	26.25	28.12	1.330	1.263	188
										500	7.95	34.24	26.70	29.06	1.505	1.429	144
	376	11.98	34.33	26.09	....	...	7.98	94	....	700	4.75	34.21	27.10	30.44	1.767	1.680	107
	460	9.18	34.27	26.54	....	...	7.87	125	....	1000	3.35	34.38	27.38	32.17	2.06	1.96	079
h	616	5.66	34.19	26.98	....	...	7.72	182	....	1500	2.40	34.52	27.58	34.77	2.42	2.32	061
14.5	869	3.81	34.32	27.29	....	...	7.64	216	....	2000	1.95	34.60	27.68	37.24	2.72	2.61	054
32°	1287	2.69	34.45	27.49	....	...	7.62	232	....	2500	1.70	34.63	27.71	39.61	2.98	2.87	0.00052
	1682	2.23	34.56	27.62	....	...	7.66	221	....								
	2042	1.93	34.56	27.64	....	...	7.68	221	....								
Station 114: June 27, 1929; 36°38' N, 143°34' E; depth bottom, 6630 m; weather, bcoz; sea, S; wind, SSE 2; good conditions; apparently very little current																	
	0	19.91	34.31	24.28	....	...	8.15	7	....	0	19.91	34.31	24.28	24.28	0.0000	0.0000	0.00366
	5	19.86	34.32	24.30	....	...	....	...	....	5	19.86	34.32	24.30	24.32	0.0192	0.0183	364
	24	18.94	34.47	24.65	....	...	....	...	....	25	18.90	34.47	24.66	24.77	0.0923	0.0878	331
	48	16.55	34.56	25.30	....	...	....	...	....	50	16.20	34.56	25.38	25.61	0.1703	0.1618	261
h	72	14.40	34.56	25.78	....	...	8.04	63	....	75	14.15	34.56	25.84	26.19	0.2338	0.2219	219
10.3	96	13.17	34.47	25.97	....	...	8.00	91	....	100	13.00	34.46	25.99	26.45	0.289	0.275	206
8°	144	11.58	34.41	26.23	....	...	7.93	114	....	150	11.45	34.40	26.24	26.94	0.392	0.372	182
	191	10.15	34.34	26.43	....	...	7.90	135	....	200	9.90	34.32	26.46	27.39	0.483	0.458	162
	286	7.91	34.19	26.67	....	...	7.80	159	....	250	8.60	34.22	26.59	27.76	0.566	0.536	150
	382	6.58[a]	34.19	26.86	....	...	7.75	189	....	300	7.65	34.19	26.71	28.12	0.643	0.608	139
	478	.....[a]	34.06	.....	....	...	7.66	208	....	400	6.40	34.17	26.87	28.77	0.782	0.741	126
										500	5.30	34.06	26.92	29.31	0.912	0.864	120
	554	.....[a]	34.08	.....	....	...	7.63	217	....	700	3.75	34.23	27.22	30.57	1.136	1.077	093
	772	3.45	34.30	27.30	....	...	7.60	232	....	1000	2.90	34.39	27.43	32.24	1.40	1.33	072
h	1107	2.76[a]	34.42	27.46	....	...	7.60	244	....	1500	2.25	34.52	27.59	34.78	1.74	1.66	060
9.2	1654	.....	34.57	.....	....	...	7.62	237	....	2000	1.85	34.61	27.69	37.25	2.03	1.95	052
10°	2167	1.81	34.63	27.71	....	...	7.69	232	....	2500	1.70	34.63	27.71	39.61	2.29	2.20	052
	2655	1.64	34.63	27.72	....	...	7.71	221	....	3000	1.60	34.63	27.72	41.96	2.55	2.47	0.00052
	3139	1.58	34.60	27.70	....	...	7.72	221	....								
Station 115: June 29, 1929; 37°40' N, 145°26' E; depth bottom, 5396 m; weather, oz; sea, MS; wind, E by S 3; good conditions; some drift towards northwest																	
	0	20.57	34.57	24.30	....	...	8.19	4	....	0	20.57	34.57	24.30	24.30	0.0000	0.0000	0.00364
h	5	20.58	34.57	24.30	....	...	8.20	...	....	5	20.58	34.57	24.30	24.32	0.0191	0.0183	364
9.4	23	20.03	34.58	24.46	....	...	8.19	8	....	25	20.00	34.59	24.47	24.58	0.0941	0.0896	349
13°	47	17.71	34.63	25.08	....	...	8.12	17	....	50	17.50	34.63	25.13	25.36	0.1777	0.1687	284
	70	16.60	34.62	25.34	....	...	8.10	23	....	75	16.50	34.62	25.36	25.71	0.2502	0.2374	265
	95	15.85	34.63	25.51	....	...	8.08	27	....	100	15.65	34.63	25.56	26.02	0.317	0.301	0.00247

[a] Thermometer did not function properly.

Table 2--Physical and chemical data and results of dynamic computations for <u>Carnegie</u> deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 115--Continued																	
	186	12.69	34.48	26.07	....	...	8.02	71	....	150	13.90	34.54	25.87	26.56	0.440	0.417	0.00218
h	281	10.56	34.32	26.34	....	...	7.92	107	....	200	12.35	34.46	26.12	27.05	0.549	0.521	195
9.4	330	8.66	34.06	26.46	....	...	7.96	100	....	250	11.35	34.38	26.24	27.40	0.649	0.616	185
13°	377	6.30[b]	33.77	26.57	....	...	7.94	103	....	300	9.95	34.26	26.40	27.80	0.743	0.705	171
	472	4.07[b]	33.63	26.70	....	...	7.86	138	....	400	5.45	33.71	26.62	28.54	0.910	0.865	149
										500	3.90	33.64	26.74	29.16	1.059	1.007	135
	479	4.01	33.63	26.71	....	...	7.84	150	....	700	3.60	34.20	27.21	30.57	1.298	1.236	094
	671	3.64	34.18	27.19	....	...	7.64	204	....	1000	3.25	34.33	27.35	32.15	1.57	1.50	081
h	959	3.35	34.30	27.31	....	...	7.58	237	....	1500	2.40	34.50	27.56	34.75	1.95	1.87	063
10.3	1434	2.49	34.47	27.53	....	...	7.58	232	....	2000	1.90	34.60	27.68	37.24	2.25	2.16	054
20°	1896	2.00	34.58	27.65	....	...	7.63	228	....	2500	1.75	34.63	27.71	39.61	2.51	2.42	0.00052
	2321	1.77	34.61	27.70	....	...	7.67	221	....								
	2753	1.75[b]	34.63	27.71	....	...	7.70	221	....								
	5360[a]	1.55	.....	.....	....	...	....	...	....								
Station 116: July 1, 1929; 38°41' N, 147°41' E; depth bottom, 5545 m; weather, bz; sea, MS; wind, SE 1-2; good conditions; drifting toward north																	
	0	16.07	34.02	24.99	....	...	8.17	4	....	0	16.07	34.02	24.99	24.99	0.0000	0.0000	0.00298
	5	16.10	34.01	24.98	....	...	8.19	4	....	5	16.10	34.01	24.98	25.00	0.0157	0.0150	299
	22	15.41	33.99	25.12	....	...	8.16	9	....	25	15.10	33.99	25.19	25.30	0.0767	0.0729	280
h	43	11.18	33.79	25.83	....	...	8.11	23	....	50	10.65	33.79	25.91	26.15	0.1414	0.1341	210
9.4	65	9.77	34.05	26.27	....	...	8.02	79	....	75	8.95	33.79	26.20	26.55	0.1936	0.1836	185
24°	353	4.69	34.00	26.94	....	...	7.67	131	....	100	6.70	33.80	26.54	27.01	0.238	0.226	152
	444	4.15	34.09	27.07	....	...	7.63	170	....	150	5.10	33.79	26.72	27.44	0.313	0.297	134
	535	4.02	34.18	27.15	....	...	7.60	196	....	200	4.80	33.79	26.76	27.71	0.385	0.364	132
										250	4.75	33.83	26.80	28.00	0.453	0.428	128
	111	5.88	33.80	26.65	....	...	7.88	200	....	300	4.70	33.90	26.86	28.29	0.520	0.492	124
	223	4.74	33.80	26.78	....	...	7.77	204	....	400	4.30	34.05	27.02	28.95	0.642	0.609	110
	335	4.64	33.96	26.91	....	...	7.68	213	....	500	4.10	34.15	27.12	29.53	0.752	0.715	101
	668	3.60	34.25	27.25	....	...	7.59	217	....	700	3.50	34.27	27.28	30.64	0.947	0.904	088
h	781	3.32	34.30	27.32	....	...	7.59	217	....	1000	2.85	34.40	27.44	32.25	1.19	1.14	071
10.8	1114	2.67	34.45	27.49	....	...	7.61	217	....	1500	2.20	34.57	27.64	34.83	1.52	1.46	054
21°	1665	2.09	34.59	27.65	....	...	7.63	217	....	2000	1.90	34.61	27.69	37.25	1.80	1.73	053
	2205	1.79	34.62	27.71	....	...	7.66	208	....	2500	1.65	34.63	27.72	39.63	2.05	1.98	050
	2698	1.62	34.64	27.73	....	...	7.70	208	....	3000	1.60	34.64	27.73	41.97	2.30	2.24	0.00051
	3225	1.55	34.64	27.74	....	...	7.73	204	....								
	5513[a]	1.53	.....	.....	....	...	....	...	....								
Station 117: July 3, 1929; 40°20' N, 150°58' E; depth bottom, 5296 m; weather, o; sea, S; wind, SE 0-2; good conditions; practically calm																	
	0	15.93	34.32	25.26	....	...	8.17	3	....	0	15.93	34.32	25.26	25.26	0.0000	0.0000	0.00272
h	5	15.94	34.29	25.23	....	...	8.18	3	....	5	15.94	34.29	25.23	25.25	0.0144	0.0137	275
9.3	24	14.80	34.21	25.43	....	...	8.16	4	....	25	14.80	34.21	25.43	25.54	0.0705	0.0669	257
5°	48	12.56	34.22	25.89	....	...	8.06	51	....	50	12.50	34.21	25.90	26.14	0.1323	0.1254	211
	72	10.40	34.10	26.20	....	...	8.04	76	....	75	10.15	34.09	26.23	26.58	0.1842	0.1746	182
	96	8.93	34.06	26.41	....	...	7.98	84	....	100	8.80	34.06	26.43	26.90	0.229	0.218	0.00163

[a] Piano wire. [b] Temperature from pressure-thermometer and wire depth.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

	Observed values									Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 117--Continued																	
	144	7.95	34.01	26.52	....	...	7.96	106	....	150	7.80	34.00	26.54	27.25	0.313	0.296	0.00152
h	191	6.64	33.88	26.60	....	...	7.91	129	....	200	6.40	33.85	26.61	27.56	0.392	0.372	147
9.3	286	4.86	33.77	26.74	....	...	7.85	157	....	250	5.25	33.78	26.70	27.90	0.467	0.442	137
5°	382	4.57	33.87	26.85	....	...	7.70	208	....	300	4.75	33.77	26.73	28.16	0.539	0.511	136
	479	4.33	34.02	26.99	....	...	7.63	244	....	400	4.50	33.89	26.87	28.79	0.676	0.642	125
										500	4.25	34.05	27.02	29.42	0.799	0.759	110
	472	4.34	34.02	26.99	....	...	7.64	244	....	700	3.60	34.23	27.23	30.59	1.010	0.961	092
	662	3.71	34.20	27.20	....	...	7.59	261	....	1000	3.05	34.39	27.42	32.22	1.27	1.21	074
	946	3.16	34.37	27.39	....	...	7.61	261	....	1500	2.25	34.53	27.60	34.79	1.62	1.55	059
h	1417	2.34	34.52	27.58	....	...	7.60	256	....	2000	1.95	34.58	27.66	37.22	1.91	1.84	056
10.4	1876	2.00	34.57	27.65	....	...	7.64	256	....	2500	1.70	34.63	27.71	39.61	2.18	2.10	0.00052
7°	2314	1.78	34.62	27.71	....	...	7.66	249	....								
	2755	1.65	34.65	27.74	....	...	7.69	244	....								
	5261[a]	1.56	.....	.....	....	...	....	...	....								
Station 118: July 5, 1929; 42°29' N, 155°24' E; depth bottom, 5404 m; weather, omf; sea, S; wind, SSE 3; fair conditions; considerable current																	
	0	10.18	33.61	25.85	....	...	8.21	90	....	0	10.18	33.61	25.85	25.85	0.0000	0.0000	0.00216
	5	10.21	33.58	25.82	....	...	8.21	90	....	5	10.21	33.58	25.82	25.84	0.0115	0.0109	219
	22	7.99	33.54	26.14	....	...	8.21	92	....	25	8.00	33.54	26.14	26.26	0.0545	0.0516	188
	45	8.33	33.72	26.24	....	...	8.21	92	....	50	8.15	33.73	26.27	26.51	0.1027	0.0971	176
h	68	7.53	33.76	26.38	....	...	8.00	103	....	75	6.90	33.77	26.48	26.83	0.1468	0.1390	158
10.2	91	6.27	33.78	26.57	....	...	7.94	114	....	100	6.10	33.78	26.60	27.07	0.187	0.177	146
23°	182	4.98	33.72	26.68	....	...	7.91	129	....	150	5.35	33.75	26.66	27.38	0.262	0.248	140
	228	4.62	33.68	26.68	....	...	7.91	138	....	200	4.80	33.70	26.69	27.65	0.337	0.318	138
	274	4.32	33.70	26.74	....	...	7.84	162	....	250	4.45	33.68	26.71	27.91	0.409	0.386	136
	321	4.20	33.79	26.82	....	...	7.73	185	....	300	4.25	33.73	26.77	28.21	0.480	0.454	133
	368	3.88	33.79	26.86	....	...	7.68	213	....	400	3.80	33.87	26.93	28.86	0.610	0.580	118
										500	3.65	34.00	27.04	29.45	0.729	0.693	108
	377	3.95	33.85	26.90	....	...	7.67	228	....	700	3.75	34.22	27.21	30.56	0.940	0.895	094
	472	3.69	33.97	27.02	....	...	7.61	237	....	1000	2.70	34.38	27.43	32.24	1.20	1.14	072
h	665	3.78	34.19	27.18	....	...	7.60	249	....	1500	2.30	34.50	27.57	34.76	1.55	1.49	062
9.3	957	2.82	34.33	27.39	....	...	7.56	261	....	2000	2.00	34.55	27.63	37.18	1.87	1.79	058
26°	1443	2.33	34.49	27.56	....	...	7.59	256	....	2500	1.70	34.58	27.67	39.57	2.15	2.07	0.00056
	1920	2.02	34.54	27.62	....	...	7.63	249	....								
	2362	1.79	34.51	27.62	....	...	7.67	244	....								
Station 119: July 7, 1929; 45°24' N, 159°36' E; depth bottom, 5198 m; weather, fmr; sea, S; wind, SSE 2; some current setting to north-northwest																	
	0	6.91	32.96	25.85	....	...	7.96	142	....	0	6.91	32.96	25.85	25.85	0.0000	0.0000	0.00216
	5	6.90	32.98	25.86	....	...	7.96	146	....	5	6.90	32.98	25.86	25.88	0.0114	0.0108	215
	22	5.87	33.01	26.01	....	...	7.96	150	....	25	6.00	33.01	26.00	26.12	0.0554	0.0525	202
	45	3.42	33.05	26.31	....	...	7.93	165	....	50	3.00	33.07	26.37	26.62	0.1039	0.0985	166
h	67	1.71	33.13	26.52	....	...	7.85	185	....	75	1.65	33.15	26.54	26.90	0.1458	0.1382	151
9.6	90	.....[b]	33.13	.....	....	...	7.85	193	....	100	1.60	33.22	26.60	27.08	0.185	0.175	146
24°	183	3.02	33.75	26.90	....	...	7.59	249	....	150	2.55	33.53	26.77	27.50	0.257	0.244	129
	230	3.29	33.89	26.99	....	...	7.54	269	....	200	3.15	33.81	26.94	27.90	0.322	0.305	113
	277	3.38	33.98	27.06	....	...	7.53	276	....	250	3.35	33.93	27.02	28.23	0.380	0.359	106
	324	3.41	34.04	27.10	....	...	7.53	284	....	300	3.40	34.01	27.08	28.52	0.435	0.411	102
	375	3.36	34.08	27.14	....	...	7.53	276	....	400	3.25	34.13	27.19	29.13	0.537	0.509	0.00093

[a] Piano wire. [b] Thermometer off scale.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

	Observed values									Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 119--Continued																	
	72	1.77	33.15	26.53	....	...	7.86	180	....	500	3.15	34.23	27.28	29.70	0.629	0.598	0.00085
	97	1.60	33.21	26.59	....	...	7.84	185	....	700	2.85	34.30	27.36	30.73	0.798	0.762	079
	393	3.30	34.15	27.20	....	...	7.54	276	....	1000	2.50	34.41	27.48	32.30	1.02	0.98	068
h	493	3.18	34.23	27.27	....	...	7.53	276	....	1500	2.05	34.53	27.61	34.81	1.35	1.30	057
10.6	593	3.06	34.26	27.31	....	...	7.56	276	....	2000	1.80	34.60	27.69	37.25	1.63	1.58	052
30°	693	2.90	34.30	27.36	....	...	7.56	276	....	2500	1.70	34.63	27.71	39.61	1.89	1.83	0.00052
	997	2.49	34.41	27.48	....	...	7.57	269	....								
	1510	2.07	34.53	27.61	....	...	7.64	269	....								
	2006	1.78	34.60	27.69	....	...	7.76	256	....								
	5170[a)]	1.54	.....	.....	....	...	....	...	....								
Station 120: July 9, 1929; 47°02' N, 166°20' E; depth bottom, 5874[b)]m; weather, omf; sea, MC; wind, W 4; fair conditions																	
	0	7.15	32.95	25.81	....	...	7.98	137	....	0	7.15	32.95	25.81	25.81	0.0000	0.0000	0.00220
	5	7.13	32.94	25.80	....	...	7.99	138	....	5	7.13	32.94	25.80	25.82	0.0116	0.0111	221
	23	5.48	33.07	26.11	....	...	7.96	153	....	25	5.45	33.07	26.11	26.23	0.0551	0.0523	191
	47	2.17	33.06	26.41	....	...	7.90	177	....	50	2.15	33.07	26.44	26.69	0.1014	0.0960	159
h	68	2.05[d)]	33.11	26.48	....	...	7.88	185	....	75	2.05	33.13	26.49	26.85	0.1431	0.1355	156
10.4	93	....	33.18	.....	....	...	7.84	197	....	100	2.00	33.20	26.53	27.01	0.183	0.174	152
19°	141	2.14	33.45	26.74	....	...	7.72	224	....	150	2.20	33.50	26.78	27.51	0.257	0.244	128
	188	3.13	33.80	26.94	....	...	7.56	284	....	200	3.20	33.85	26.97	27.93	0.321	0.304	111
	236	3.32	33.93	27.03	....	...	7.53	296	....	250	3.35	33.95	27.04	28.25	0.378	0.357	104
	284	3.35	33.97	27.06	....	...	7.53	293	....	300	3.35	33.99	27.07	28.51	0.433	0.409	103
	383	3.29	34.11	27.17	....	...	7.53	289	....	400	3.30	34.14	27.19	29.13	0.535	0.508	093
										500	3.15	34.22	27.27	29.69	0.628	0.597	086
	402	3.27	34.15	27.20	....	...	7.53	289	....	700	2.95	34.29	27.35	30.72	0.799	0.763	080
	505	3.15	34.22	27.27	....	...	7.55	281	....	1000	2.55	34.39	27.46	32.28	1.03	0.99	070
h	716	2.92	34.30	27.36	....	...	7.57	281	....	1500	2.10	34.50	27.58	34.78	1.36	1.32	060
9.4	1047	2.52	34.40	27.47	....	...	7.59	281	....	2000	1.85	34.58	27.67	37.23	1.66	1.61	055
35°	1609[c)]	2.39	34.45	27.52	....	...	7.59	277	....	2500	1.65	34.62	27.71	39.62	1.92	1.87	0.00051
	2183	1.80	34.60	27.69	....	...	7.66	260	....								
	2718	1.63	34.63	27.72	....	...	7.71	248	....								
Station 121: July 11, 1929; 46°05' N, 171°32' E. depth bottom, 5684 m; weather, co; sea, MS; wind, NNE 2; good conditions; very little current																	
	0	7.46	32.93	25.74	....	...	7.98	141	....	0	7.46	32.93	25.74	25.74	0.0000	0.0000	0.00226
	5	7.45	32.95	25.76	....	...	8.00	141	....	5	7.45	32.95	25.76	25.78	0.0119	0.0113	225
	24	6.38	33.03	25.94	....	...	7.98	142	....	25	6.30	33.03	25.98	26.10	0.0571	0.0542	204
	48	3.77	33.06	26.28	....	...	7.92	159	....	50	3.55	33.06	26.31	26.56	0.1067	0.1012	172
h	72	2.56	33.09	26.42	....	...	7.89	172	....	75	2.35	33.09	26.44	26.80	0.1506	0.1429	161
10.2	96	2.01	33.16	26.52	....	...	7.86	184	....	100	2.05	33.18	26.53	27.01	0.191	0.182	152
11°	144	2.37	33.45	26.72	....	...	7.71	224	....	150	2.40	33.47	26.74	27.47	0.267	0.252	131
	191	3.01	33.70	26.87	....	...	7.57	268	....	200	3.05	33.74	26.90	27.86	0.333	0.315	117
	236	3.24	33.90	27.01	....	...	7.54	296	....	250	3.30	33.91	27.01	28.22	0.392	0.371	107
	286	3.36	33.94	27.03	....	...	7.53	296	....	300	3.40	33.96	27.04	28.48	0.449	0.424	105
	383	3.40	34.07	27.13	....	...	7.54	292	....	400	3.35	34.09	27.15	29.09	0.554	0.525	0.00097

a) Piano wire. b) Sonic depths 5777 m at 47°03' N, 166°11' E and 5874 m at 47°02' N, 166°28' E. c) Water-bottle probably reversed at higher level; values rejected. d) Thermometer off scale.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 121--Continued																	
	437	3.25	34.12	27.18	....	...	7.54	292	....	500	3.20	34.17	27.23	29.65	0.651	0.618	0.00089
	547	3.15	34.20	27.25	....	...	7.54	284	....	700	2.95	34.27	27.33	30.70	0.828	0.789	082
h	768	2.85	34.29	27.36	....	...	7.55	280	....	1000	2.55	34.39	27.46	32.28	1.06	1.02	070
9.2	1104	2.46	34.44	27.51	....	...	7.56	280	....	1500	2.10	34.54	27.61	34.81	1.39	1.34	057
13°	1656	1.98	34.56	27.64	....	...	7.63	272	....	2000	1.85	34.58	27.67	37.23	1.68	1.63	055
	2170[a]	2.21	34.48	27.56	....	...	7.60	276	....	2500	1.80	34.61	27.70	39.60	1.94	1.89	0.00053
	2641	1.77	34.62	27.71	....	...	7.66	265	....								
Station 122: July 13, 1929; 46°16' N, 174°03' E; depth bottom, 6077[b]m; weather, fr; sea, MC; wind, SSE 2-4; bad conditions; some current towards northeast																	
	0	8.22	32.84	25.58	....	...	7.98	130	....	0	8.22	32.84	25.58	25.58	0.0000	0.0000	0.00242
	4	8.19	32.84	25.59	....	...	7.99	130	....	5	8.20	32.84	25.59	25.61	0.0127	0.0121	241
	22	7.44	32.88	25.70	....	...	7.99	130	....	25	7.30	32.88	25.74	25.86	0.0620	0.0588	226
	45	4.03	33.06	26.26	....	...	7.94	142	....	50	3.60	33.07	26.31	26.56	0.1146	0.1085	172
h	67	2.92	33.10	26.40	....	...	7.92	157	....	75	2.70	33.11	26.42	26.78	0.1587	0.1505	163
10.9	90	2.54	33.13	26.45	....	...	7.90	161	....	100	2.40	33.14	26.47	26.95	0.201	0.190	158
27°	135	2.12	33.20	26.54	....	...	7.88	172	....	150	2.20	33.26	26.59	27.32	0.281	0.266	146
	182	2.41	33.44	26.71	....	...	7.74	209	....	200	2.50	33.52	26.77	27.74	0.354	0.336	130
	273	2.93	33.80	26.96	....	...	7.60	261	....	250	2.80	33.73	26.91	28.12	0.419	0.397	116
	365	3.30	33.98	27.06	....	...	7.58	272	....	300	3.05	33.86	26.99	28.43	0.479	0.454	110
	460	3.28	34.10	27.16	....	...	7.56	272	....	400	3.30	34.03	27.10	29.04	0.590	0.560	102
										500	3.20	34.14	27.20	29.62	0.691	0.657	092
	642	3.10	34.26	27.31	....	...	7.56	268	....	700	3.00	34.29	27.34	30.71	0.870	0.830	081
	1107	2.52	34.41	27.48	....	...	7.59	265	....	1000	2.65	34.39	27.45	32.26	1.11	1.06	070
h	1386	2.27	34.48	27.55	....	...	7.64	265	....	1500	2.15	34.51	27.59	34.78	1.45	1.39	059
9.3	1846	1.94	34.57	27.65	....	...	7.66	257	....	2000	1.85	34.58	27.67	37.23	1.74	1.68	055
31°	2268	1.75	34.59	27.68	....	...	7.69	249	....	2500	1.65	34.60	27.70	39.61	2.00	1.94	052
	2691	1.63	34.63	27.72	....	...	7.72	240	....	3000	1.60	34.63	27.72	41.96	2.26	2.20	0.00052
	3100	1.57	34.63	27.73	....	...	7.75	237	....								
Station 123: July 15, 1929; 50°27' N, 172°51' W; depth bottom, 5464[c]m; weather, ofm; sea, RC; wind, S by E 5-6; almost impossible conditions; deep series not reversed because of large wire angle																	
	0	8.10	32.76	25.52	....	...	8.03	113	....	0	8.10	32.76	25.52	25.52	0.0000	0.0000	0.00247
h	4	8.08	32.74	25.51	....	...	8.03	114	....	5	8.05	32.74	25.51	25.53	0.0131	0.0124	248
10.8	21	8.05	32.75	25.52	....	...	8.04	118	....	25	8.00	32.80	25.55	25.67	0.0651	0.0616	244
43°	41	5.00	32.87	26.00	....	...	7.96	145	....	50	4.40	32.88	26.08	26.33	0.1229	0.1163	194
	60	3.97	32.90	26.13	....	...	7.92	163	....	75	3.45	32.95	26.23	26.59	0.1723	0.1633	181
	77	3.54	32.95	26.22	....	...	7.91	176	....	100	3.00	33.39	26.62	27.10	0.215	0.204	144
										150	3.15	33.73	26.88	27.61	0.284	0.269	118
h	93	2.94	33.26	26.52	....	...	7.79	209	....	200	3.30	33.89	27.00	27.96	0.345	0.326	108
11.2	122	2.98	33.60	26.79	....	...	7.63	252	....	250	3.40	33.99	27.06	28.27	0.400	0.378	103
56°	180	3.30	33.84	26.95	....	...	7.54	284	....	300	3.40	34.04	27.10	28.54	0.454	0.429	0.00100

[a] Water bottle probably reversed at higher level; values rejected. [b] Sonic depths 6077 m at 46°11' N, 173°57' E and 5662 m at 46°37' N, 174°36' E. [c] Sonic depths 5464 m at 50°22' N, 173°03' W and 5755 m at 50°40' N, 171°41' W.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

	Observed values									Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 123--Continued																	
h	240	3.38	33.98	27.05	....	...	7.53	288	....	400	3.30	34.12	27.18	29.12	0.555	0.527	0.00094
11.2	339	3.36	34.07	27.13	....	...	7.53	292	....	500	3.25	34.18	27.23	29.65	0.650	0.618	089
56°	511	3.24	34.19	27.24	....	...	7.53	284	....	700[a]	3.00	34.28	27.33	30.70	0.827	0.789	082
										1000	2.70	34.39	27.44	32.25	1.07	1.02	071
										1500	2.15	34.52	27.60	34.80	1.40	1.35	058
										2000	1.85	34.59	27.68	37.24	1.69	1.63	053
										2500	1.70	34.62	27.71	39.61	1.95	1.89	0.00052
Station 124: July 17, 1929; 52°19' N, 162°02' W; depth bottom, 4780[b]m; weather, o; sea, RC; wind, S 6; bad conditions; drifting; used two 85-pound weights on bottle-wire																	
	0	9.30	32.66	25.26	....	...	8.04	103	....	0	9.30	32.66	25.26	25.26	0.0000	0.0000	0.00272
	5	9.29	32.65	25.26	....	...	8.04	106	....	5	9.29	32.65	25.26	25.28	0.0143	0.0137	272
	25	8.71	32.67	25.36	....	...	8.03	106	....	25	8.71	32.67	25.36	25.48	0.0707	0.0672	263
	50	5.38	32.73	25.85	....	...	8.02	110	....	50	5.38	32.73	25.85	26.10	0.1338	0.1270	216
h	76	4.12	33.02	26.22	....	...	7.83	176	....	75	4.15	33.01	26.19	26.55	0.1866	0.1772	185
9.5	101	4.05	33.69	26.76	....	...	7.64	228	....	100	4.05	33.65	26.73	27.21	0.228	0.217	133
38°	203	3.78	33.98	27.01	....	...	7.54	276	....	150	3.85	33.89	26.94	27.66	0.293	0.278	113
	306	3.65	34.06	27.09	....	...	7.55	272	....	200	3.75	33.98	27.02	27.98	0.352	0.333	105
	407	3.54	34.17	27.19	....	...	7.54	284	....	250	3.70	34.02	27.06	28.26	0.407	0.386	107
	515	3.38	34.23	27.26	....	...	7.54	280	....	300	3.65	34.06	27.09	28.53	0.462	0.438	102
	735	3.08	34.31	27.35	....	...	7.54	272	....	400	3.55	34.16	27.18	29.11	0.564	0.537	094
	1081	2.54	34.46	27.51	....	...	7.57	265	....	500	3.40	34.22	27.25	29.66	0.659	0.628	088
										700	3.10	34.31	27.35	30.71	0.834	0.796	080
	779	2.98	34.36	27.40	....	...	7.56	269	....	1000	2.70	34.43	27.47	32.28	1.07	1.02	069
h	1150	2.45	34.49	27.55	....	...	7.58	261	....	1500	2.10	34.56	27.63	34.83	1.39	1.34	055
10.4	1812	1.95	34.58	27.66	....	...	7.62	252	....	2000	1.85	34.60	27.68	37.24	1.67	1.61	053
45°	2427	1.72	34.65	27.73	....	...	7.68	244	....	2500	1.70	34.63	27.71	39.61	1.93	1.87	0.00052
Station 125: July 19, 1929; 51°58' N, 150°39' W; depth bottom, 4536[c]m; weather, om; sea, R; wind, SW by W 6; poor conditions; vessel rolling in rough sea; 170 pounds and heavy messengers on bottle-wire																	
	0	10.50	32.75	25.13	....	...	8.03	125	....	0	10.50	32.75	25.13	25.13	0.0000	0.0000	0.00284
	5	10.48	32.74	25.13	....	...	8.03	126	....	5	10.48	32.74	25.13	25.15	0.0150	0.0143	284
	24	10.10	32.73	25.18	....	...	8.04	129	....	25	10.10	32.73	25.18	25.30	0.0745	0.0706	280
	46	5.68[d]	32.79	25.88	....	...	7.98	138	....	50	5.50	32.80	25.89	26.13	0.1394	0.1321	212
	66	5.02	32.82	25.97	....	...	7.94	145	....	75	4.70	32.84	26.02	26.38	0.1940	0.1838	201
h	87	4.34	32.87	26.09	....	...	7.92	154	....	100	4.20	32.94	26.15	26.63	0.245	0.232	189
9.3	175	3.71	33.82	26.90	....	...	7.57	237	....	150	3.80	33.75	26.83	27.55	0.327	0.310	124
35°	263	3.54	33.91	26.99	....	...	7.56	265	....	200	3.65	33.85	26.92	27.88	0.392	0.371	116
	355	3.60	34.01	27.06	....	...	7.56	280	....	250	3.55	33.90	26.98	28.19	0.451	0.427	111
	446	3.49	34.10	27.14	....	...	7.56	276	....	300	3.55	33.95	27.02	28.46	0.509	0.482	108
	651	3.26	34.23	27.27	....	...	7.56	272	....	400	3.55	34.06	27.10	29.03	0.618	0.588	102
	970	2.79	34.38	27.43	....	...	7.59	265	....	500	3.40	34.14	27.18	29.59	0.721	0.686	094
										700	3.15	34.25	27.30	30.66	0.908	0.865	085
h	981	2.80	34.36	27.41	....	...	7.58	261	....	1000	2.75	34.38	27.43	32.24	1.15	1.10	072
10.3	1523	2.23	34.51	27.58	....	...	7.60	261	....	1500	2.25	34.51	27.58	34.77	1.50	1.44	061
45°	2069	1.94	34.59	27.67	....	...	7.63	257	....	2000	2.00	34.58	27.65	37.20	1.81	1.74	057
	2575	1.74	34.62	27.71	....	...	7.69	244	....	2500	1.80	34.62	27.71	39.61	2.08	2.00	0.00052

[a] Values below 500 meters extrapolated. [b] Sonic depths 4780 m at 52°14' N, 162°22' W and 4550 m at 52°29' N, 160°58' W. [c] Sonic depths 4536 m at 51°59' N, 150°55' W and 4717 m at 51°45' N, 149°52' W. [d] Temperature (5°.44) by second thermometer rejected.

Table 2--Physical and chemical data and results of dynamic computations for <u>Carnegie</u> deep sea stations, 1928-1929--Continued

L.M.T. and wire angle	Observed values: Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	Interpolated values: A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Computed values: Density (σ_{tP})	Anomalies: Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 126: July 21, 1929; 48°05' N, 142°56' W; depth bottom, 4382[a]m; weather, cm; sea, RL; wind, W 6; strong wind, up to 7 at times; 170 pounds and heavy messengers on bottle wire																	
	0	11.25	32.63	24.90	....	...	8.09	76	....	0	11.25	32.63	24.90	24.90	0.0000	0.0000	0.00306
	5	11.26	32.61	24.89	....	...	8.09	76	....	5	11.26	32.61	24.89	24.91	0.0162	0.0154	307
	25	11.20	32.57	24.87	....	...	8.09	78	....	25	11.20	32.57	24.87	24.99	0.0812	0.0770	309
	47	8.03	32.68	25.47	....	...	8.04	91	....	50	7.75	32.68	25.51	25.75	0.1547	0.1466	248
h	73	6.48[b]	32.69	25.69	....	...	8.00	105	....	75	6.45	32.69	25.69	26.04	0.2182	0.2067	232
10.4	98	.....	32.70	.....	....	...	8.01	100	....	100	6.40	32.70	25.71	26.18	0.279	0.264	230
34°	196	5.98	33.78	26.61	....	...	7.86	149	....	150	6.25	33.61	26.44	27.15	0.383	0.362	161
	294	5.13	33.88	26.80	....	...	7.68	236	....	200	5.95	33.79	26.62	27.57	0.465	0.439	146
	344	4.49	33.93	26.91	....	...	7.60	261	....	250	5.55	33.84	26.71	27.91	0.539	0.509	137
	396	4.10	33.97	26.98	....	...	7.59	276	....	300	5.10	33.89	26.80	28.23	0.609	0.576	130
	513	3.80	34.11	27.12	....	...	7.57	280	....	400	4.05	33.97	26.98	28.91	0.736	0.699	114
										500	3.85	34.09	27.10	29.51	0.849	0.807	103
	556	3.73	34.14	27.15	....	...	7.54	292	....	700	3.45	34.24	27.26	30.62	1.048	1.000	090
h	784	3.29	34.27	27.30	....	...	7.54	292	....	1000	2.95	34.36	27.40	32.20	1.31	1.25	076
9.3	1136	2.72	34.57	27.59	....	...	7.54	288	....	1500	2.30	34.48	27.55	34.74	1.67	1.61	064
36°	1731	2.14	34.52	27.60	....	...	7.58	280	....	2000	1.95	34.55	27.64	37.20	1.99	1.91	057
	2315	1.82	34.60	27.68	....	...	7.64	269	....	2500	1.70	34.61	27.70	39.60	2.26	2.18	0.00053
	2837	1.65	34.63	27.72	....	...	7.68	257	....								
Station 127: July 23, 1929; 44°16' N, 137°37' W; depth bottom, 4026[c]m; weather, bc; sea, M; wind, W by S 4; good conditions; 120 pounds and heavy messengers on bottle wire																	
	0	13.35	32.69	24.57	....	...	8.12	43	....	0	13.35	32.69	24.57	24.57	0.0000	0.0000	0.00338
	6	13.36	32.72	24.58	....	...	8.12	42	....	5	13.35	32.72	24.58	24.61	0.0177	0.0169	337
	24	13.32[e]	32.70	24.57	....	...	8.13	42	....	25	13.30	32.70	24.58	24.69	0.0887	0.0844	338
	47	11.04	32.75	25.04	....	...	8.09	56	....	50	10.50	32.76	25.14	25.38	0.1707	0.1620	283
h	72	8.80	32.82	25.46	....	...	8.03	67	....	75	8.65	32.82	25.48	25.83	0.2414	0.2291	253
9.2	96	8.30	32.78	25.50	....	...	8.00	72	....	100	8.25	32.78	25.51	25.99	0.307	0.292	250
22°	144	7.78	33.16	25.78	....	...	7.97	88	....	150	7.75	33.24	25.95	26.67	0.428	0.406	209
	195	7.03	33.84	26.52	....	...	7.91	133	....	200	7.00	33.84	26.53	27.48	0.524	0.498	155
	293	6.20	33.90	26.68	....	...	7.77	184	....	250	6.55	33.88	26.62	27.81	0.603	0.573	147
	394	4.98	33.91	26.84	....	...	7.64	228	....	300	6.15	33.90	26.68	28.11	0.679	0.646	142
	493	4.24	33.97	26.96	....	...	7.59	261	....	400	4.95	33.91	26.84	28.76	0.819	0.781	128
										500	4.15	33.97	26.98	29.39	0.946	0.902	114
	499	4.16	33.97	26.98	....	...	7.58	265	....	700	3.75	34.04	27.07	30.42	1.177	1.124	108
	701	3.73	34.03	27.06	....	...	7.54	276	....	1000	3.05	34.31	27.35	32.15	1.48	1.41	081
	1009	3.08	34.32	27.36	....	...	7.54	284	....	1500	2.40	34.47	27.54	34.73	1.85	1.78	065
h	1526	2.38	34.48	27.55	....	...	7.56	284	....	2000	2.00	34.57	27.65	37.20	2.17	2.09	057
10.2	2027	1.95	34.58	27.66	....	...	7.61	269	....	2500	1.75	34.61	27.70	39.60	2.44	2.36	0.00053
31°	2480	1.75	34.61	27.69	....	...	7.67	261	....								
	2939	1.62	34.62	27.71	....	...	7.68	261	....								
	3988[d]	1.56	.....	.....	....	...	....	...	....								
	4004[d]	1.56	.....	.....	....	...	....	...	....								

[a] Sonic depths 4382 m at 48°09' N, 143°04' W and 4424 m at 47°40' N, 142°18' W. [b] Thermometer did not function properly. [c] Mean of 4018 and 4034 meters. [d] Piano wire. [e] Temperature (13.71°) by second thermometer rejected.

	Observed values									Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 128: July 25, 1929; 40°37' N, 132°23' W; depth bottom, 3806[a] m; weather, o; sea, ML; wind, SW 4-5; fair conditions; considerable drift; 170 pounds on bottle wire																	
	0	16.41	32.95	24.10	....	...	8.12	29	....	0	16.41	32.95	24.10	24.10	0.0000	0.0000	0.00383
	5	16.39	32.91	24.07	....	...	8.12	29	....	5	16.39	32.91	24.07	24.10	0.0202	0.0193	386
	24	15.05	33.02	24.45	....	...	8.12	29	....	25	15.05	33.02	24.45	24.56	0.0976	0.0930	351
	49	11.88	33.07	25.13	....	...	8.11	29	....	50	11.75	33.07	25.16	25.40	0.1809	0.1721	282
h	73	10.48	33.08	25.39	....	...	8.08	39	....	75	10.45	33.08	25.40	25.75	0.2524	0.2400	261
10.4	96	10.23	33.14	25.48	....	...	8.06	46	....	100	10.20	33.15	25.49	25.96	0.320	0.304	252
22°	145	9.21	33.38	25.84	....	...	8.00	78	....	150	9.00	33.42	25.90	26.62	0.442	0.420	213
	194	7.97	33.75	26.31	....	...	7.92	110	....	200	7.90	33.77	26.34	27.29	0.544	0.517	173
	291	6.93	33.93	26.61	....	...	7.82	151	....	250	7.40	33.88	26.50	27.69	0.631	0.599	158
	387	5.83	33.95	26.76	....	...	7.72	189	....	300	6.90	33.93	26.61	28.04	0.712	0.676	149
										400	5.65	33.95	26.79	28.70	0.859	0.818	134
	431	5.13	33.96	26.85	....	...	7.65	216	....	500	4.60	34.02	26.97	29.37	0.989	0.943	116
	540	4.40	34.07	27.03	....	...	7.59	244	....	700	3.95	34.18	27.16	30.51	1.213	1.159	100
h	759	3.83	34.21	27.19	....	...	7.55	261	....	1000	3.30	34.39	27.39	32.18	1.49	1.43	078
9.5	1093	3.12	34.44	27.45	....	...	7.56	265	....	1500	2.45	34.49	27.54	34.73	1.86	1.79	065
33°	1655	2.24	34.49	27.57	....	...	7.61	265	....	2000	1.95	34.55	27.64	37.20	2.18	2.10	0.00057
	2180	1.86	34.58	27.67	....	...	7.64	240	....								
	3755[b]	1.58	.....	.....	....	...	....	...	....								
	3796[b]	1.58	.....	.....	....	...	....	...	....								
Station 129: July 27, 1929; 38°50' N, 126°02' W; depth bottom, 4171[c] m; weather, cbc; sea, RCL; wind, NW by N 6-7; conditions seemed hopeless but current was against wind and wire angle only 20°, so program was carried out; very heavy seas																	
	0	16.29	33.13	24.26	....	...	8.13	25	....	0	16.29	33.13	24.26	24.26	0.0000	0.0000	0.00368
	5	16.29	33.07	24.22	....	...	8.13	27	....	5	16.29	33.07	24.22	24.25	0.0194	0.0185	371
	25	16.27	33.10	24.24	....	...	8.13	...	....	25	16.27	33.10	24.24	24.35	0.0974	0.0926	370
	51	16.26	33.12	24.26	....	...	8.13	25	....	50	16.25	33.12	24.26	24.49	0.1947	0.1849	368
h	76	13.51	32.96	24.73	....	...	8.12	27	....	75	13.60	32.96	24.71	25.06	0.2862	0.2718	327
10.1	103	11.07	33.03	25.24	....	...	8.08	34	....	100	11.25	33.01	25.20	25.67	0.366	0.348	281
20°	155	9.70	33.42	25.79	....	...	7.92	114	....	150	9.80	33.37	25.73	26.44	0.500	0.475	229
	208	8.60	33.76	26.22	....	...	7.78	165	....	200	8.70	33.72	26.18	27.13	0.611	0.580	190
	284	6.82	33.92	26.61	....	...	7.73	198	....	250	7.65	33.86	26.45	27.64	0.702	0.668	164
	420	5.72	34.01	26.82	....	...	7.64	236	....	300	6.60	33.94	26.66	28.09	0.783	0.746	144
										400	5.85	34.00	26.80	28.71	0.927	0.885	133
	495	5.30	34.03	26.89	....	...	7.61	245	....	500	5.25	34.02	26.89	29.28	1.062	1.013	123
h	622	4.61	34.02	26.97	....	...	7.57	272	....	700	4.40	34.07	27.03	30.38	1.308	1.248	112
9.2	877	4.10	34.29	27.23	....	...	7.56	284	....	1000	3.80	34.39	27.34	32.12	1.61	1.54	084
18°	1267	3.17	34.47	27.47	....	...	7.57	284	....	1500	2.70	34.49	27.52	34.70	2.01	1.93	068
	1896	2.14	34.52	27.60	....	...	7.63	272	....	2000	2.05	34.53	27.62	37.17	2.34	2.25	059
	2507	1.81	34.59	27.68	....	...	7.67	257	....	2500	1.80	34.59	27.68	39.58	2.62	2.53	0.00056
Station 130: September 4, 1929; 37°05' N, 123°43' W; depth bottom, 3188 m; weather, o; sea, MS; wind, S 0-1; good conditions; new German meter wheel No. 2 used for piano wire																	
	0	16.24	33.40	24.48	5.74	101	8.34	36	....	0	16.24	33.40	24.48	24.48	0.0000	0.0000	0.00347
h	5	16.23	33.43	24.50	5.71	101	8.27	34	....	5	16.23	33.43	24.50	24.53	0.0182	0.0173	345
8.6	22	15.63	33.38	24.60	5.78	101	8.21	39	....	25	15.50	33.38	24.63	24.74	0.0895	0.0852	333
15°	46	12.91	33.40	25.19	6.10	101	8.26	83	....	50	11.70	33.42	25.44	25.68	0.1670	0.1586	255
	67	9.98	33.62	25.89	4.53	71	8.20	149	....	75	9.45	33.66	26.01	26.36	0.2274	0.2160	0.00203

a) Mean of 3785 and 3826 meters. b) Piano wire. c) Sonic depths 4171 m at 38°52' N, 126°11' W and 3511 m at 38°41' N, 125°16' W.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 130--Continued																	
	92	8.96	33.72	26.14	3.46	53	8.06	176	....	100	8.85	33.74	26.17	26.64	0.279	0.265	0.00188
h	187	7.77	34.02	26.56	1.78	27	8.04	198	....	150	8.15	33.91	26.41	27.12	0.372	0.353	165
8.6	279	7.00	34.11	26.74	1.20	18	8.03	221	....	200	7.65	34.04	26.59	27.53	0.455	0.432	150
15°	373	6.26	34.08	26.81	0.82	12	7.94	257	....	250	7.20	34.10	26.70	27.88	0.531	0.504	139
	467	5.70	34.15	26.94	0.72	10	8.00	271	....	300	6.80	34.11	26.77	28.19	0.603	0.572	134
										400	6.05	34.09	26.85	28.76	0.740	0.704	128
	476	5.59	34.16	26.96	0.72	10	7.94	270	....	500	5.45	34.18	26.99	29.37	0.867	0.825	114
	665	4.99	34.32	27.16	0.25	4	....	287	....	700	4.85	34.33	27.18	30.52	1.090	1.038	099
h	951	3.86	34.39	27.34	0.43	6	7.93	286	....	1000	3.70	34.40	27.36	32.14	1.37	1.31	082
10.8	1424	2.80	34.54	27.55	0.98	13	7.95	254	....	1500	2.65	34.56	27.59	34.77	1.74	1.67	061
9°	1890	2.10	34.60	27.66	1.48	19	7.96	263	....	2000	2.00	34.61	27.68	37.23	2.04	1.97	054
	2322	1.84	34.60	27.68	2.00	26	8.12	243	....	2500	1.75	34.62	27.71	39.61	2.30	2.22	0.00052
	2771	1.70	34.64	27.72	2.38	31	7.97	247	....								
Station 131: September 6, 1929; 33°49' N, 126°20' W; depth bottom, 4418 m; weather, od; sea, MS; wind, NW 3; good conditions																	
	0	19.13	33.37	23.76	5.32	98	8.34	...	....	0	19.13	33.37	23.76	23.76	0.0000	0.0000	0.00415
	5	19.14	33.37	23.76	5.38	99	8.36	...	....	5	19.14	33.37	23.76	23.79	0.0218	0.0208	415
	24	17.72 b)	33.23	24.00	5.11	92	8.32	...	....	25	17.70	33.23	24.01	24.12	0.1067	0.1015	392
	47	13.98	33.24	25.00	6.28	106	8.39	...	....	50	13.85	33.25	24.88	25.11	0.1991	0.1830	308
h	72	13.14	33.38	25.13	6.08	101	8.34	...	....	75	13.00	33.38	25.16	25.51	0.2773	0.2631	284
9.4	99	12.12	33.36	25.31	6.08	100	8.32	...	....	100	12.10	33.36	25.32	25.79	0.350	0.332	269
8°	191	10.61	33.52	25.71	4.99	80	8.24	...	....	150	11.15	33.43	25.55	26.25	0.486	0.461	247
	286	8.11	33.95	26.45	2.89	44	8.12	...	....	200	10.40	33.54	25.76	26.69	0.612	0.581	231
	382	6.58	33.96	26.68	1.85	27	8.04	...	....	250	8.90	33.79	26.20	27.38	0.721	0.685	188
	478	5.69	34.10	26.90	1.11	16	7.95	...	....	300	7.85	33.95	26.50	27.92	0.813	0.772	160
	668	4.61	34.25	27.14	0.29	4	8.01	...	....	400	6.35	33.98	26.72	28.63	0.969	0.923	140
										500	5.50	34.12	26.94	29.32	1.106	1.052	118
	659	4.61	34.27	27.16	0.22	3	7.90	...	....	700	4.45	34.28	27.18	30.52	1.334	1.268	098
	942	3.74	34.39	27.35	0.33	5	7.82	...	....	1000	3.60	34.40	27.37	32.15	1.61	1.54	080
	1413	2.78	34.47	27.50	1.03	14	7.99	...	....	1500	2.60	34.49	27.53	34.71	2.00	1.91	067
h	1877	2.15	34.60	27.66	1.60	21	7.96	...	....	2000	2.05	34.61	27.68	37.23	2.31	2.22	054
10.7	2294	1.84	34.60	27.69	2.00	26	7.89	...	....	2500	1.75	34.61	27.70	39.60	2.58	2.48	053
22°	2753	1.66	34.59	27.69	2.44	32	7.97 c)	...	....	3000	1.60	34.62	27.72	41.96	2.84	2.75	052
	3166	1.58	34.64	27.73	2.76	36	8.03 c)	...	....	3500	1.55	34.65	27.75	44.28	3.09	3.00	0.00050
	3575 a)	1.53	34.65	27.75	2.77	36	8.20 c)	...	....								
	4388 a)	1.55	.....	.....	....	...	....	...	....								
Station 132: September 8, 1929; 31°38' N, 128°48' W; depth bottom, 4251 m; weather, bc; sea, S; wind, NW 2-0; good conditions																	
	0	21.04	33.91	23.66	5.10	97	8.34	15	....	0	21.04	33.91	23.66	23.66	0.0000	0.0000	0.00425
	5	21.05	33.91	23.66	5.09	97	8.36	17	....	5	21.05	33.91	23.66	23.69	0.0223	0.0213	425
	23	21.01	33.88	23.66	5.08	97	8.34	13	....	25	21.00	33.88	23.66	23.77	0.1117	0.1064	426
	47	18.38	33.89	24.35	5.78	106	8.33	...	....	50	17.55	33.87	24.55	24.78	0.2127	0.2021	340
h	70	14.86	33.38	24.77	5.90	102	8.33	19	....	75	14.75	33.38	24.80	25.15	0.2994	0.2845	318
9.6	93	14.42	33.40	24.88	5.82	99	8.30	16	....	100	14.30	33.41	24.92	25.39	0.381	0.362	307
15°	185	10.07	33.57	25.84	4.49	71	8.14	90	....	150	11.45	33.50	25.55	26.25	0.527	0.501	247
	279	8.13	33.94	26.44	2.72	41	7.96	170	....	200	9.60	33.62	25.96	26.90	0.649	0.616	211
	374	6.83	34.00	26.68	1.86	27	7.87	208	....	250	8.60	33.91	26.34	27.52	0.749	0.712	174
	471	5.87	34.06	26.84	1.10	16	7.81	237	....	300	7.80	33.95	26.50	27.92	0.837	0.795	160
	673	4.66	34.21	27.11	0.29	4	7.76	255	....	400	6.55	34.01	26.72	28.62	0.994	0.946	0.00140

a) Piano wire. b) Temperature mean of 17°.67 and 17°.78. c) Sample bottles not completely filled; value rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

	Observed values									Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 132--Continued																	
	711	4.50	34.22	27.14	0.29	4	7.76	269	....	500	5.65	34.08	26.89	29.27	1.134	1.078	0.00124
	1015	3.65	34.41	27.37	0.54	7	7.75	267	....	700	4.55	34.22	27.13	30.47	1.372	1.305	103
	1513	2.79	34.51	27.53	1.10	15	7.81	261	....	1000	3.70	34.40	27.36	32.14	1.66	1.58	082
h	1997	2.12	34.59	27.65	1.70	22	7.87	251	....	1500	2.80	34.51	27.53	34.70	2.05	1.96	067
10.6	2440	1.82	34.61	27.70	2.10	28	7.84	236	....	2000	2.10	34.59	27.66	37.21	2.37	2.28	057
6°	2891	1.64	34.60	27.70	2.48	32	7.90	245	....	2500	1.80	34.61	27.70	39.60	2.64	2.54	053
	3304	1.55	34.62	27.73	2.89	38	7.91	248	....	3000	1.60	34.61	27.71	41.95	2.90	2.82	053
	3715	1.53	34.63	27.73	....	...	7.95	218	....	3500	1.55	34.62	27.73	44.26	3.16	3.08	0.00052
	4221[a]	1.55	.....	.....	....	...	....	...	....								
Station 133: September 10, 1929; 29°21' N, 132°30' W; depth bottom, 4426 m; weather, oc; sea, MS; wind, NNE 3; good conditions																	
	0	22.68	34.70	23.82	4.95	98	8.47	7	640	0	22.68	34.70	23.82	23.82	0.0000	0.0000	0.00409
	5	22.68	34.70	23.82	5.00	99	8.42	7	610[b]	5	22.68	34.70	23.82	23.85	0.0215	0.0205	409
	23	22.68	34.79	23.89	4.89	97	8.35	7	4850	25	22.65	34.79	23.89	24.00	0.1070	0.1018	404
	46	21.21	34.70	24.23	5.33	103	8.37	7	630	50	20.75	34.70	24.35	24.58	0.2076	0.1971	359
h	69	19.28	34.70	24.74	5.52	103	8.34	7	510	75	19.05	34.72	24.82	25.16	0.2967	0.2816	316
9.2	93	18.51	34.76	24.98	5.38	99	8.31	7	630	100	18.40	34.76	25.01	25.46	0.378	0.358	299
15°	184	15.26	34.32	25.41	4.93	86	8.30	21	1000	150	16.95	34.54	25.19	25.88	0.531	0.504	283
	279	9.99	33.94	26.14	4.71	74	8.12	90	1300	200	14.40	34.23	25.52	26.44	0.673	0.638	253
	373	7.80	34.03	26.56	3.10	47	7.98	145	2590	250	11.10	33.96	25.97	27.14	0.795	0.754	211
	471	6.34	33.99	26.72	2.19	32	7.83	201	3100	300	9.30	33.95	26.27	27.68	0.898	0.853	183
	661	4.68	34.19	27.09	0.53	7	7.74	255	3900	400	7.35	34.01	26.61	28.51	1.073	1.020	151
										500	5.95	34.01	26.80	29.18	1.222	1.162	133
h	533	5.51	.....	.....	1.43	20	7.79	247	3750[b]	700	4.55	34.22	27.13	30.47	1.469	1.398	103
11.2	581	5.11	34.08	26.95	0.95	13	7.76	263	7250	1000	3.75	34.40	27.35	32.13	1.76	1.68	083
17°	630	4.86	.....	.....	....	...	7.76	271	5600	1500	2.80	34.56	27.57	34.74	2.14	2.05	063
	723	4.51	.....	.....	0.33	5	7.74	288	5500	2000	2.15	34.62	27.68	37.22	2.45	2.35	055
	657	4.68	34.19	27.09	0.51	7	....	...	....	2500	1.75	34.63	27.71	39.61	2.72	2.61	0.00052
	758	4.37	.....	.....	0.30	4	7.75	251	6510								
	801	4.23	34.29	27.22	0.27	4	7.75	260	5800								
h	935	3.89	34.37	27.32	0.46	6	7.75	263	8150								
10.2	1418	2.92	34.54	27.55	1.17	16	....	...	....								
28°	1884	2.25	34.62	27.67	1.55	21	7.83	240	10540								
	2307	1.89	34.63	27.71	2.07	27	....	...	....								
	2739	1.67	34.64	27.72	2.42	32	7.91	236	....								
	4396[a]	1.57	.....	.....	....	...	....	...	....								
Station 134: September 12, 1929; 27°45' N, 135°22' W; depth bottom, 4528 m; weather, bc; sea, MS; wind, SE 1; good conditions																	
	0	22.89	34.70	23.75	4.95	98	8.34	6	590	0	22.89	34.70	23.75	23.75	0.0000	0.0000	0.00416
	5	22.91	34.70	23.75	4.90	97	8.34	7	925[b]	5	22.91	34.70	23.75	23.78	0.0219	0.0209	416
h	23	22.89	34.73	23.78	4.92	97	8.34	6	3300	25	22.85	34.73	23.79	23.90	0.1091	0.1037	413
8.9	47	19.97	34.57	24.46	5.52	105	8.34	6	920	50	19.75	34.56	24.51	24.74	0.2089	0.1983	344
5°	70	18.47	34.49	24.78	5.52	102	8.32	6	530	75	18.40	34.49	24.80	25.14	0.2963	0.2812	318
	94	18.18	34.63	24.96	5.29	97	8.34	6	910	100	18.10	34.63	24.98	25.43	0.378	0.358	0.00302

[a] Piano wire. [b] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 134--Continued																	
	189	16.32	34.49	25.30	5.01	89	8.30	13	1400	150	17.25	34.59	25.16	25.85	0.533	0.505	0.00286
h	281	10.01	33.93	26.13	4.46	70	8.14	96	1260	200	15.90	34.44	25.36	26.28	0.680	0.645	269
8.9	375	7.86	33.99	26.52	2.99	45	7.95	154	3100	250	12.30	33.99	25.76	26.93	0.810	0.769	231
5°	470	6.33	34.00	26.74	1.88	27	7.87	197	4150	300	9.50	33.94	26.22	27.63	0.920	0.874	188
	658	4.96	34.22	27.08	0.38	5	7.75	255	6170	400	7.35	33.99	26.59	28.49	1.098	1.045	153
										500	6.00	34.04	26.81	29.19	1.248	1.188	132
	747	4.50	34.29	27.19	0.32	4	7.75	295	6850	700	4.70	34.26	27.15	30.49	1.492	1.421	101
	841	4.24	34.36	27.27	0.41	6	7.74	285	6580	1000	3.90	34.46	27.39	32.16	1.78	1.69	080
	887	4.12	34.41	27.33	0.49	7	....	...	....	1500	2.90	34.52	27.54	34.71	2.16	2.07	067
h	934	4.03	34.44	27.36	0.57	8	7.75	276	9880	2000	2.15	34.60	27.66	37.20	2.48	2.38	057
9.8	1400	3.04	34.51	27.51	1.11	15	....	...	....	2500	1.80	34.62	27.71	39.61	2.75	2.65	0.00052
9°	1864	2.31	34.57	27.63	1.58	21	7.81	255	10700								
	2298	1.91	34.62	27.70	1.81	24	....	...	....								
	2741	1.67	34.62	27.71	2.45	32	7.89	230	8950								
	4498[a]	1.58	.....	.....	....	...	....	...	....								
Station 135: September 14, 1929; 26°39' N, 139°07' W; depth bottom, 4695 m; weather, o; sea, S; wind, 0; good conditions																	
	0	23.76	35.12	23.83	4.78	96	8.37	7	550	0	23.76	35.12	23.83	23.83	0.0000	0.0000	0.00408
	5	23.77	35.14	23.83	5.30	107	8.37	5	550	5	23.77	35.14	23.83	23.85	0.0215	0.0204	407
	23	23.72	35.27	23.95	4.76	116	8.37	5	540	25	23.70	35.27	23.96	24.07	0.1063	0.1008	397
	47	21.83	35.01	24.29	5.31	104	8.37	5	590	50	21.50	35.01	24.39	24.62	0.2055	0.1948	355
h	70	20.18	35.00	24.73	5.25	100	8.37	5	520	75	19.85	34.98	24.80	25.14	0.2944	0.2790	318
8.9	94	18.95	34.88	24.96	5.07	94	8.34	5	580	100	18.70	34.85	25.00	25.45	0.376	0.356	300
5°	188	16.13	34.47	25.33	....	...	8.28	24	670	150	17.05	34.62	25.23	25.92	0.528	0.501	279
	288	10.03	33.98	26.16	4.17	66	8.12	95	1270	200	15.75	34.38	25.34	26.26	0.674	0.639	270
	376	8.05	33.96	26.48	3.67	56	8.01	137	1980	250	12.20	34.10	25.87	27.04	0.802	0.761	220
	469	6.40	33.97	26.71	2.20	32	7.87	193	3230	300	9.65	33.97	26.23	27.64	0.909	0.863	187
	658	4.74	34.19	27.08	0.50	7	7.73	268	5750	400	7.55	33.96	26.54	28.43	1.090	1.036	158
										500	5.95	33.99	26.78	29.16	1.244	1.182	135
	1027	3.60	34.48	27.43	0.83	11	7.75	263	6400	700	4.55	34.24	27.14	30.48	1.492	1.419	102
	1542	2.70	34.52	27.55	1.40	19	7.78	256	9250	1000	3.65	34.47	27.42	32.20	1.77	1.69	075
	2008	2.06	34.60	27.66	1.80	24	7.83	263	10000	1500	2.75	34.52	27.55	34.73	2.14	2.04	065
h	2433	1.79	34.63	27.71	2.20	29	7.85	257	9750	2000	2.05	34.60	27.67	37.22	2.45	2.35	055
10.0	2884	1.58	34.61	27.71	2.67	35	7.87	244	9750	2500	1.75	34.62	27.71	39.61	2.71	2.61	052
5°	3301	1.52	34.64	27.74	2.92	38	7.90	244	9750[b]	3000	1.55	34.63	27.73	41.97	2.97	2.87	050
	3736	1.51	34.65	27.75	3.11	40	7.90	241	8900	3500	1.50	34.64	27.74	44.27	3.22	3.12	051
	4098	1.53	34.63	27.73	3.15	41	7.90	240	9000	4000	1.55	34.64	27.74	46.54	3.48	3.38	0.00052
	4660[a]	1.56	.....	.....	....	...	....	...	....								
Station 136: September 16, 1929; 26°13' N, 142°02' W; depth bottom, 4713 m; weather, bc; sea, S; wind, SE 3; good conditions; piano wire fouled reversing frame and thermometers were about horizontal																	
	0	24.59	35.38	23.77	4.82	99	8.37	3	600	0	24.59	35.38	23.77	23.77	0.0000	0.0000	0.00414
	5	24.60	35.37	23.76	4.77	98	8.39	3	560	5	24.60	35.37	23.76	23.78	0.0218	0.0207	414
h	24	24.46	35.37	23.80	4.80	98	8.39	3	620	25	24.40	35.37	23.82	23.93	0.1087	0.1032	410
8.8	48	21.62	35.13	24.44	5.38	105	8.39	3	620	50	21.40	35.12	24.50	24.73	0.2083	0.1975	345
13°	71	20.00	35.10	24.86	5.28	100	8.39	3	560	75	19.75	35.09	24.91	25.25	0.2944	0.2791	307
	95	18.87	35.02	25.09	5.21	97	8.39	3	650	100	18.65	35.01	25.14	25.59	0.373	0.353	286
	188	15.95	34.58	25.45	5.39	95	8.30	13	1100	150	17.25	34.80	25.32	26.01	0.520	0.492	0.00270

[a] Piano wire. [b] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 136--Continued																	
h	282	11.04	34.05	26.05	5.26	85	8.19	67	1650	200	15.35	34.50	25.53	26.45	0.658	0.623	0.00252
8.8	379	8.71	34.04	26.43	4.16	64	8.12	119	1510	250	12.70	34.17	25.83	26.99	0.783	0.742	224
13°	474	6.57	34.00	26.71	2.77	41	7.95	188	2500	300	10.45	34.04	26.14	27.54	0.894	0.847	196
	663	4.71	34.15	27.06	0.83	12	7.76	292	4100	400	8.20	34.03	26.50	28.39	1.081	1.026	162
										500	6.10	34.01	26.78	29.16	1.238	1.175	135
	950	3.80	34.42	27.37	0.69	9	7.76	311	6100	700	4.55	34.20	27.11	30.45	1.489	1.415	105
	1413	2.92	34.54	27.55	1.26	17	7.81	283	6400	1000	3.65	34.44	27.39	32.17	1.78	1.69	078
h	1884	2.21	34.61	27.67	1.74	23	....	...	....	1500	2.75	34.55	27.57	34.75	2.15	2.05	063
12.0	2311	1.83	34.62	27.70	1.82	24	7.87	271	7600	2000	2.10	34.61	27.67	37.22	2.45	2.35	056
19°	2760	1.61	34.63	27.72	2.55	33	....	...	....	2500	1.70	34.62	27.71	39.61	2.72	2.61	0.00052
	....a)	2.48	34.53	.....	....	...	....	...	....								
	....a)	1.99	34.62	.....	....	...	....	...	....								
	4044b)	1.57	34.65	27.74	2.80	36	7.93	241	6950								
Station 137: September 18, 1929; 24°02' N, 145°33' W; depth bottom, 5208 m; weather, b; sea, MC; wind, NE by E 4; fair conditions																	
	0	25.48	34.97	23.19	4.64	96	8.39	4	600	0	25.48	34.97	23.19	23.19	0.0000	0.0000	0.00470
	5	25.50	34.96	23.18	4.62	95	8.38	5	660	5	25.50	34.96	23.18	23.20	0.0247	0.0236	471
	22	25.47	34.97	23.20	4.71	97	8.37	4	510	25	25.45	34.97	23.20	23.31	0.1236	0.1177	470
	46	24.84	35.12	23.50	4.94	101	8.34	4	600	50	24.45	35.11	23.61	23.84	0.2421	0.2301	430
h	68	22.52	34.92	24.03	5.05	100	8.37	5	530	75	22.25	34.93	24.11	24.45	0.3493	0.3320	384
9.6	91	21.72	35.07	24.37	4.98	97	8.30	5	620	100	21.50	35.08	24.44	24.89	0.446	0.424	353
22°	182	18.60	35.08	25.20	4.88	91	8.28	4	660	150	19.85	35.10	24.90	25.58	0.621	0.589	310
	275	12.40c)	34.15	25.87	4.17	69	8.14	62	770	200	17.70	34.93	25.31	26.22	0.776	0.736	274
	372	9.15	34.04	26.36	3.97	62	8.06	126	1830	250	14.15	34.27	25.61	26.76	0.913	0.866	246
	468	6.96	34.06	26.70	2.18	32	7.87	224	2920	300	11.15	34.10	26.07	27.46	1.031	0.978	202
	662	5.17	34.28	27.11	0.54	8	7.73	288	4500	400	8.40	34.04	26.48	28.37	1.224	1.161	164
										500	6.45	34.08	26.79	29.16	1.381	1.310	134
	1056	3.80	34.48	27.41	0.93	13	7.75	302	6100	700	5.00	34.31	27.15	30.49	1.628	1.546	102
	1584	2.73	34.57	27.58	1.49	20	7.81	288	7050	1000	3.95	34.46	27.38	32.15	1.91	1.82	080
	2092	2.08d)	34.60	27.66	1.99	26	....	...	....	1500	2.85	34.56	27.57	34.74	2.29	2.18	063
h	2566	1.77	34.63	27.71	2.36	31	7.87	265	8200	2000	2.15	34.60	27.66	37.20	2.61	2.49	057
10.9	3051	1.57	34.64	27.73	2.80	36	....	...	....	2500	1.80	34.63	27.71	39.61	2.87	2.75	052
22°	3496	1.52	34.65	27.75	3.07	40	7.90	229	7600	3000	1.60	34.64	27.73	41.97	3.13	3.02	051
	3938	1.51	34.65	27.75	3.20	42	....	...	....	3500	1.50	34.65	27.75	44.28	3.38	3.27	050
	4343	1.53	34.65	27.75	3.46	45	7.90	226	7600	4000	1.50	34.65	27.75	46.55	3.63	3.52	0.00051
	5168b)	1.52	.....	.....	....	...	....	...	....								
Station 138: September 20, 1929; 22°53' N, 151°15' W; depth bottom, 5382 m; weather, bc; sea, MC; wind, NE by E 4; rather bad conditions; vessel drifting and surging																	
	0	26.14	34.85	22.90	4.65	97	8.35	5	580	0	26.14	34.85	22.90	22.90	0.0000	0.0000	0.00497
h	4	26.15	34.83	22.88	4.65	97	8.32	3	580	5	26.15	34.83	22.88	22.90	0.0262	0.0249	499
8.9	20	26.14	34.83	22.88	4.64	97	8.30	3	520	25	26.10	34.83	22.89	23.00	0.1312	0.1248	499
35°	41	26.05	34.81	22.89	4.66	97	8.30	3	520	50	25.60	34.74	22.98	23.21	0.2614	0.2485	491
	62	23.11	34.64	23.65	1.99e)	40	8.28	3	520	75	22.90	34.75	23.79	24.13	0.3805	0.3618	0.00415

a) Water bottles probably reversed at depths of about 2200 and 1800 meters when being lowered; values rejected. b) Piano wire.
c) Temperature mean of 12°.35 and 12°.45. d) Temperature (2°.81) by second thermometer rejected. e) Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 138--Continued																	
	83	.....[b]	34.83	.....	4.77	94	8.31	3	500	100	22.20	34.85	24.06	24.51	0.486	0.462	0.00390
	167	21.18	34.96	24.43	4.92	95	8.31	3	500	150	21.45	34.94	24.34	25.02	0.685	0.650	364
h	210	20.38	35.25	24.86	4.81	92	8.26	3	470	200	20.60	35.23	24.79	25.69	0.867	0.823	324
8.9	252	18.24	34.90	25.15	4.54	84	8.23	13	610	250	18.50	34.94	25.12	26.26	1.029	0.977	293
35°	339	11.33	34.14	26.07	4.68	76	8.08	72	1220	300	13.35	34.31	25.81	27.19	1.167	1.107	228
	426	8.48	34.04	26.47	3.86	59	8.01	142	2140	400	9.10	34.05	26.38	28.26	1.379	1.309	175
										500	6.80	34.07	26.74	29.11	1.544	1.466	139
	90	22.40[c]	34.80	23.97	....	...	8.30	5	570	700	4.90	34.22	27.09	30.43	1.802	1.713	108
	648	5.17	34.18	27.03	0.82	12	7.75	315	3030	1000	4.10	34.46	27.37	32.14	2.10	2.00	082
	744	4.73	34.29	27.16	0.62	9	7.75	...	5440	1500	2.90	34.54	27.55	34.72	2.48	2.37	066
	842	4.45	34.39	27.28	0.76	11	7.75	312	5620	2000	2.25	34.60	27.66	37.20	2.80	2.69	057
h	941	4.27	34.45	27.34	0.88	12	7.75	302	6020	2500	1.85	34.61	27.69	39.58	3.08	2.96	0.00055
9.9	1433	3.07	34.53	27.52	1.40	19	7.75	285	6330								
37°	1921	2.33	34.60	27.64	1.87	25	7.81	276	7460								
	2375	1.92	34.61	27.69	2.28	30	7.85	255	7810[d]								
	2840	1.70	34.62	27.71	2.53	33	7.85	245	7580								
	5342[a]	1.52	.....	.....	....	...	....	...	....								
Station 139: September 22, 1929; 21°47' N, 155°31' W; depth bottom, 5030 m; weather, bc; sea, M; wind, ESE 3; fair conditions; two lowest water bottles probably reversed when lowered; values rejected																	
	0	26.72	34.82	22.69	4.65	98	8.34	6	560	0	26.72	34.82	22.69	22.69	0.0000	0.0000	0.00517
	5	26.72	34.82	22.69	4.63	97	8.34	6	560	5	26.72	34.82	22.69	22.71	0.0272	0.0259	517
	23	26.70	34.85	22.72	4.58	96	8.28	6	530	25	26.70	34.85	22.72	22.83	0.1358	0.1291	515
	46	26.70	34.85	22.72	4.67	98	8.31	6	560	50	25.75	34.87	23.03	23.26	0.2675	0.2542	486
h	69	24.60	34.96	23.45	5.05	103	8.31	6	530	75	24.20	35.01	23.61	23.95	0.3882	0.3690	432
8.8	93	22.78	35.18	24.15	4.98	99	8.28	6	570	100	22.35	35.17	24.27	24.72	0.493	0.469	370
16°	187	16.92	34.65	25.28	4.11	74	8.16	8	720	150	18.95	34.96	25.02	25.70	0.670	0.636	299
	235	13.17	34.25	25.80	3.91	66	8.08	70	940	200	15.80	34.50	25.43	26.35	0.819	0.777	262
	283	11.25	34.14	26.08	4.40	71	8.04	92	1270	250	12.35	34.20	25.92	27.08	0.944	0.896	215
	332	10.30	34.11	26.23	4.42	70	8.03	115	1370	300	10.85	34.13	26.14	27.53	1.053	0.999	195
	381	8.84	34.05	26.42	3.71	57	7.93	165	2000	400	8.35	34.06	26.50	28.39	1.241	1.178	162
										500	6.30	34.11	26.83	29.21	1.395	1.324	130
	458	7.03	34.08	26.71	2.73	40	7.78	235	2900	700	4.90	34.29	27.14	30.48	1.638	1.557	103
	642	5.05	34.23	27.08	1.08	15	7.65	297	4570	1000	4.05	34.52	27.42	32.19	1.92	1.83	077
h	913	4.33	34.48	27.36	0.92	13	7.65	319	6020	1500	2.80	34.58	27.58	34.75	2.28	2.18	062
9.8	1360	3.02	34.57	27.56	1.47	20	7.67	302	7050	2000	2.10	34.60	27.66	37.21	2.59	2.48	057
25°	1815	2.32	34.59	27.64	1.94	26	7.72	288	7580	2500	1.80	34.64	27.72	39.62	2.86	2.75	0.00051
	2238	1.89	34.63	27.71	2.35	31	7.75	279	7700								
	4990[a]	1.49	.....	.....	....	...	....	...	....								
Station 140: October 3, 1929; 23°26' N, 159°27' W; depth bottom, 4762 m; weather, bc; sea, MR; wind, ENE 5; fair conditions; strong trade wind																	
	0	26.91	35.04	22.80	4.56	96	8.42	7	860	0	26.91	35.04	22.80	22.80	0.0000	0.0000	0.00507
h	5	26.92	35.04	22.80	4.55	96	8.39	7	720	5	26.92	35.04	22.80	22.82	0.0267	0.0254	507
9.0	22	26.91	34.93	22.72	4.54	96	8.39	7	660	25	26.90	34.93	22.72	22.83	0.1341	0.1276	515
22°	46	26.87	35.02	22.80	4.58	97	8.39	7	660	50	26.90	35.02	22.79	23.02	0.2688	0.2556	509
	68	26.89	35.03	22.80	4.46	94	8.38	7	550	75	26.85	35.03	22.81	23.15	0.4026	0.3829	509
	91	25.94	35.02	23.09	4.80	100	8.34	7	760	100	25.50	35.03	23.23	23.68	0.531	0.505	0.00470

[a] Piano wire. [b] Thermometer did not function. [c] Temperature (22°.01) by second thermometer rejected. [d] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep-sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 140--Continued																	
	182	21.05	35.40	24.80	4.88	94	8.33	7	740	150	22.75	35.33	24.28	24.95	0.752	0.715	0.00371
h	228	19.39	35.18	25.08	4.35	82	8.32	7	530	200	20.35	35.36	24.96	25.86	0.932	0.886	308
9.0	275	16.52	34.46	25.23	4.48	80	8.21	7	760	250	18.00	34.90	25.21	26.35	1.088	1.033	285
22°	323	13.23	34.25	25.78	4.27	72	8.07	20	1450	300	14.65	34.32	25.54	26.91	1.230	1.168	254
	371	10.57	34.15	26.21	4.43	71	8.07	80	1540	400	9.65	34.05	26.29	28.17	1.460	1.388	184
										500	7.15	34.02	26.65	29.02	1.635	1.554	148
	375	10.64	34.06	26.12	4.34	69	8.04	68	1920	700	4.75	34.19	27.08	30.42	1.903	1.811	109
	470	7.78	34.01	26.55	3.77	57	7.89	110	2780	1000	3.85	34.44	27.38	32.16	2.20	2.10	080
	656	5.02	34.14	27.01	0.97	14	7.66	121	6330	1500	2.75	34.52	27.54	34.72	2.58	2.47	066
h	937	4.03	34.41	27.33	0.88	12	....	...	....	2000	2.15	34.59	27.65	37.19	2.90	2.78	058
10.2	1335a)	3.18	34.53	.....	1.36	18	7.71	201	7700	2500	1.85	34.62	27.70	39.59	3.17	3.05	0.00054
39°	1399	2.95	34.51	27.52	1.41	19	....	...	....								
	1646a)	2.95	34.57	......	1.50	20	....	...	....								
	1961a)	2.23	34.60	.....	2.05	27	7.73	190	6750								
	4722b)	1.55	.....	.....	....	...	....	...	....								
Station 141: October 5, 1929; 29°02' N, 161°11' W; depth bottom, 5667 m; weather, bc; sea, MC; wind, ENE 5; fair conditions; no trace of bottom sample																	
	0	25.89	35.19	23.24	4.74	99	8.34	5	890c)	0	25.89	35.19	23.24	23.24	0.0000	0.0000	0.00465
	5	25.91	35.20	23.24	4.65	97	8.34	5	1160	5	25.91	35.20	23.24	23.26	0.0245	0.0233	465
	23	25.90	35.19	23.23	4.63	96	8.34	5	470	25	25.90	35.19	23.23	23.34	0.1225	0.1165	467
	46	25.31	35.26	23.46	4.86	100	8.34	5	1630	50	24.75	35.26	23.63	23.86	0.2403	0.2283	428
h	69	22.65	35.19	24.20	4.93	98	8.34	5	530	75	22.20	35.16	24.30	24.64	0.3449	0.3277	366
8.9	90	20.79	35.10	24.64	5.29	102	8.33	5	980c)	100	20.00	35.05	24.82	25.27	0.435	0.413	317
16°	184	15.55	34.53	25.50	4.66	82	8.21	43	1880c)	150	16.90	34.74	25.36	26.05	0.589	0.559	267
	230	14.29	34.38	25.67	4.32	74	8.19	50	1160	200	15.10	34.46	25.55	26.47	0.726	0.689	250
	277	12.71	34.27	25.90	4.73	79	8.12	64	1010	250	13.65	34.32	25.75	26.91	0.852	0.809	232
	324	11.76	34.24	26.06	4.80	79	8.10	78	2380	300	12.15	34.25	26.00	27.39	0.969	0.919	210
	371	11.14	34.21	26.15	4.77	77	8.11	83	2380	400	10.65	34.16	26.20	28.07	1.180	1.121	193
										500	8.45	34.04	26.47	28.83	1.369	1.301	166
	369	11.14	34.18	26.13	4.80	77	8.08	83	1440	700	5.00	34.00	26.90	30.24	1.674	1.592	125
	464	9.20	34.07	26.38	4.31	67	8.00	129	2060	1000	3.60	34.29	27.28	32.07	2.01	1.92	090
	654	5.48	33.98	26.83	2.26	33	....	...	....	1500	2.70	34.47	27.51	34.69	2.42	2.32	069
h	946	3.75	34.24	27.23	0.46	6	7.57	322	5950	2000	1.95	34.55	27.64	37.20	2.75	2.64	057
10.2	1433	2.83	34.46	27.49	1.12	15	....	...	....	2500	1.70	34.63	27.71	39.61	3.01	2.90	0.00052
31°	1907	2.10	34.53	27.60	1.80	24	7.69	257	7050								
	2341	1.80	34.63	27.71	2.19	29	....	...	....								
	2784	1.63	34.64	27.73	2.72	35	7.78	244	7580								
	5627b)	1.63	.....	.....	....	...	....	...	....								
Station 142: October 7, 1929; 32°42' N, 160°44' W; depth bottom, 5787 m; weather, bc; sea, MS; wind, 0; fairly good conditions																	
	0	24.07	34.85	23.53	4.83	98	8.33	5	560c)	0	24.07	34.85	23.53	23.53	0.0000	0.0000	0.00437
h	5	24.08	34.90	23.57	4.84	98	8.33	5	470	5	24.08	34.90	23.57	23.59	0.0229	0.0218	433
9.0	24	23.75	34.86	23.63	4.83	97	8.33	5	620	25	23.70	34.86	23.64	23.75	0.1135	0.1078	427
7°-15°	46	22.45	34.79	23.95	5.20	102	8.30	5	200	50	21.80	34.76	24.11	24.34	0.2202	0.2089	382
	70	17.97	34.54	24.94	5.72	105	8.26	5	220	75	17.65	34.52	25.01	25.35	0.3100	0.2940	298
	93	16.90	34.47	25.15	5.60	101	8.27	7	450	100	16.55	34.45	25.22	25.68	0.386	0.366	0.00279

a) Water bottles probably reversed when being lowered; values rejected. b) Piano wire. c) Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper- ature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phos- phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper- ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 142--Continued																	
	185	13.43	34.28	25.77	4.97	84	8.17	43	1330[b]	150	14.45	34.34	25.60	26.29	0.523	0.496	0.00244
h	277	11.78	34.24	26.06	4.56	75	8.10	75	980	200	13.15	34.27	25.82	26.74	0.648	0.614	224
9.0	372	10.25	34.16	26.26	4.97	79	8.08	107	1030	250	12.20	34.25	25.99	27.15	0.761	0.722	209
7°-15°	465	8.88	34.03	26.40	4.71	73	7.97	113	1900	300	11.40	34.23	26.12	27.51	0.869	0.824	197
	650	5.69	33.94	26.79	2.76	40	7.78	206	3490	400	9.80	34.12	26.32	28.20	1.067	1.013	181
										500	8.30	34.00	26.46	28.82	1.250	1.187	167
	843	4.16	34.07	27.05	0.92	13	7.60	261	5560	700	5.10	33.96	26.86	30.20	1.560	1.483	129
	994	3.68	34.22	27.22	0.32	4	7.57	295	6340	1000	3.65	34.22	27.22	32.01	1.91	1.82	095
	1484	2.70	34.47	27.51	0.74	10	7.61	311	7050	1500	2.65	34.47	27.51	34.69	2.33	2.24	069
h	1963	2.04	34.53	27.61	1.58	21	7.67	302	7250	2000	2.00	34.54	27.62	37.17	2.67	2.56	059
10.2	2403	1.79	34.60	27.69	2.08	27	7.73	288	7700	2500	1.70	34.60	27.69	39.59	2.95	2.84	054
11°-15°	2852	1.60	34.61	27.71	2.50	33	7.73	268	7580	3000	1.55	34.61	27.71	41.95	3.21	3.11	052
	3268	1.54	34.60	27.71	2.82	37	7.77	251	7700	3500	1.50	34.62	27.73	44.26	3.47	3.37	052
	3682	1.52	34.64	27.74	3.23	42	7.81	237	7700	4000	1.55	34.62	27.72	46.52	3.74	3.63	0.00054
	4043	1.53	34.62	27.72	3.29	43	7.83	228	6660								
	5747[a]	1.65	.....	.....	....	...	....	...	....								
Station 143: October 9, 1929; 34°06' N, 157°09' W; depth bottom, 5841[c] m; weather, cqr; sea, RC; wind, SSW 6; bad conditions; vessel drifting and plunging																	
	0	22.44	34.39	23.65	5.01	98	8.30	6	460[b]	0	22.44	34.39	23.65	23.65	0.0000	0.0000	0.00426
	4	22.44	34.39	23.65	4.99	98	....	...	....	5	22.44	34.39	23.65	23.67	0.0224	0.0213	426
	20	22.42	34.41	23.67	5.01	98	....	...	....	25	22.35	34.41	23.69	23.80	0.1117	0.1062	423
	40	21.85	34.40	23.82	5.08	99	8.34	6	460	50	19.00	34.21	24.44	24.67	0.2136	0.2029	350
h	56	16.77	34.16	24.94	6.27	112	8.30	6	460	75	14.90	34.10	25.32	25.67	0.2953	0.2802	268
8.7	81	14.57	34.10	25.38	5.83	101	8.30	10	620	100	13.80	34.11	25.56	26.02	0.363	0.344	247
40°	163	12.33	34.19	25.92	5.14	85	8.20	51	620	150	12.55	34.18	25.86	26.55	0.486	0.460	218
	246	11.31	34.20	26.12	4.40	71	8.12	84	1300	200	11.85	34.20	26.02	26.95	0.598	0.567	205
	330	9.89	34.14	26.32	5.05	80	8.08	94	1220[b]	250	11.25	34.20	26.13	27.29	0.703	0.666	195
	413	8.42	34.04	26.48	4.71	72	8.04	61	1300	300	10.45	34.17	26.25	27.65	0.803	0.762	185
	500	6.95[d]	33.95	26.63	....	...	7.90	79	2670	400	8.65	34.06	26.46	28.34	0.988	0.938	167
										500	6.95	33.96	26.64	29.01	1.155	1.096	149
	506	7.01	33.98	26.63	....	...	7.92	74	2600	700	4.50	34.04	26.99	30.33	1.433	1.361	116
	591	5.56	33.99	26.83	2.73	39	7.80	95	3030	1000	3.40	34.31	27.32	32.11	1.75	1.66	085
h	722	4.34	34.05	27.02	1.30	18	7.62	122	4550	1500	2.60	34.50	27.54	34.72	2.14	2.05	066
9.6	878	3.69	34.21	27.21	0.24	3	7.59	285	6020	2000	1.95	34.57	27.65	37.21	2.46	2.36	057
45°	1388	2.74	34.47	27.50	....	...	7.60	304	7350	2500	1.70	34.60	27.69	39.59	2.73	2.63	0.00054
	1877	2.08	34.56	27.63	1.50	20	....	...	....								
	2348	1.79	34.59	27.67	1.90	25	7.73	462[b]	7700								
Station 144: October 11, 1929; 33°38' N, 151°47' W; depth bottom, 5523[e] m; weather, oqr; sea, MC; wind, SW by S 4; fair conditions; considerable drift																	
	0	23.26	34.97	23.86	4.93	98	8.37	6	300[b]	0	23.26	34.97	23.86	23.86	0.0000	0.0000	0.00406
h	4	23.28	35.02	23.89	4.95	99	8.37	6	300	5	23.30	35.02	23.88	23.90	0.0213	0.0203	404
9.1	20	23.27	34.94	23.83	4.96	99	8.37	6	220	25	23.25	34.94	23.84	23.95	0.1068	0.1015	408
40°	41	22.91[f]	34.95	23.94	4.94	98	8.39	6	340	50	21.10	34.74	24.29	24.52	0.2087	0.1981	365
	57	18.69	34.64	24.84	5.83	108	8.33	6	500	75	17.70	34.61	25.07	25.41	0.2955	0.2803	292
	81	17.46	34.59	25.11	5.67	103	8.37	6	770[b]	100	16.60	34.51	25.25	25.71	0.370	0.351	0.00276

a) Piano wire. b) Value rejected. c) Sonic depths 5841 m at 34°06' N, 157°18' W and 5889 m at 34°16' N, 158°48' W. d) Temperature from pressure thermometer and wire depth. e) Sonic depths 5523 m at 33°38' N, 151°59' W and 5523 m at 33°36' N, 151°10' W. f) Temperature (23.62) by second thermometer rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 144--Continued																	
	167	13.09	34.27	25.83	5.09	85	8.23	11	610	150	13.65	34.28	25.72	26.41	0.504	0.478	0.00231
h	255	11.37	34.30	26.18	4.70	76	8.18	55	710	200	12.25	34.29	26.01	26.94	0.620	0.588	206
9.1	343	10.00	34.16	26.32	5.04	80	8.16	106	1000	250	11.45	34.31	26.18	27.34	0.724	0.686	191
40°	438	8.45	34.06	26.49	4.66	71	8.08	134	1350	300	10.65	34.23	26.25	27.65	0.824	0.781	185
	635	5.15[a]	34.01	26.89	2.29	32	7.69	233	3530	400	9.05	34.09	26.42	28.30	1.010	0.959	171
										500	7.35	34.02	26.62	28.99	1.180	1.120	151
	900	3.73	34.21	27.20	0.49	7	7.53	268	6670	700	4.60	34.04	26.98	30.32	1.461	1.389	118
	1133	3.12	34.39	27.41	0.27	4	7.53	268	7470	1000	3.45	34.29	27.30	32.09	1.78	1.70	087
	1367	3.03	34.54	27.54	0.54	7	7.56	265	8350	1500	2.50	34.56	27.60	34.78	2.16	2.07	059
h	1831	2.11	34.58	27.64	1.28	17	....	...	....	2000	1.95	34.58	27.66	37.22	2.46	2.36	056
10.3	2274	1.81	34.59	27.68	1.87	24	7.64	245	9870	2500	1.70	34.62	27.71	39.61	2.73	2.62	052
40°	2716	1.62	34.65	27.74	2.47	32	....	...	....	3000	1.55	34.65	27.74	41.98	2.98	2.88	049
	3133	1.54	34.66	27.75	2.83	37	7.74	224	9740	3500	1.50	34.66	27.76	44.29	3.22	3.13	049
	3552	1.50	34.65	27.75	3.15	41	....	...	....	4000	1.50	34.66	27.76	46.56	3.47	3.38	0.00050
	4036	1.51	34.67	27.77	3.27	43	7.78	206	8240								
Station 145: October 13, 1929; 33°27' N, 145°30' W; depth bottom, 5584 m; weather, bc; sea, ML; wind, WNW 2-3; good conditions																	
	0	22.27	34.62	23.88	4.96	97	8.29	6	310[d]	0	22.27	34.62	23.88	23.88	0.0000	0.0000	0.00404
	5	22.29	34.67	23.90	....	...	8.31	6	260	5	22.29	34.67	23.90	23.93	0.0212	0.0202	402
	24	22.33	34.69	23.91	5.07	99	8.31	6	210	25	22.30	34.69	23.91	24.02	0.1057	0.1006	402
	48	19.16	34.32	24.48	5.77	108	8.34	6	310	50	18.70	34.31	24.59	24.82	0.2030	0.1928	336
h	72	16.58[b]	34.18	25.00	6.01	107[c]	8.31	6	310[d]	75	16.55	34.18	25.00	25.35	0.2868	0.2723	299
9.2	95	.....	34.71[d]	.....	5.41	95[c]	8.31	6	590[d]	100	15.95	34.10	25.09	25.55	0.364	0.346	291
6°	189	13.12	33.95	25.58	5.43	91	8.20	35	310	150	14.45	33.97	25.32	26.02	0.512	0.486	270
	281	10.34	34.20	26.29	4.73	75	8.09	95	610	200	12.80	33.96	25.65	26.58	0.647	0.614	241
	373	8.90	34.16	26.50	....	...	8.04	129	650	250	11.20	34.12	26.08	27.25	0.762	0.724	200
	464	6.97	33.98	26.63	3.27	48	7.83	177	2860	300	9.95	34.20	26.36	27.76	0.861	0.818	175
	565	5.30	34.02	26.89	1.91	27	7.66	229	3570	400	8.40	34.11	26.54	28.43	1.035	0.985	158
	642	4.58	34.09	27.02	1.13	16	7.60	292	3750	500	6.30	33.99	26.73	29.11	1.192	1.134	139
										700	4.30	34.13	27.08	30.42	1.451	1.381	108
	664	4.46	34.08	27.03	0.99	14	7.58	302	3900	1000	3.35	34.34	27.34	32.13	1.75	1.67	083
h	951	3.50	34.32	27.32	0.28	4	7.55	315	5000	1500	2.55	34.53	27.57	34.75	2.13	2.04	063
10.4	1188	3.01	34.41	27.44	0.43	6	7.57	311	6950	2000	2.00	34.60	27.67	37.22	2.44	2.34	055
9°	1427	2.66	34.51	27.54	0.87	11	7.60	302	7250	2500	1.70	34.63	27.71	39.61	2.70	2.60	0.00052
	1894	2.04	34.61	27.67	1.60	21	7.66	288	8340								
	2327	1.79	34.62	27.71	2.08	27	7.73	279	8770								
Station 146: October 15, 1929; 31°51' N, 140°50' W; depth bottom, 4756 m; weather, bcod; sea, MC; wind, SW to NW; fair conditions; considerable drift																	
	0	22.37	34.86	24.02	5.01	99	8.37	6	260[d]	0	22.37	34.86	24.02	24.02	0.0000	0.0000	0.00390
h	4	22.39	34.85	24.01	4.99	98	8.32	6	250	5	22.40	34.85	24.01	24.04	0.0205	0.0196	391
9.0	22	22.39	34.87	24.03	5.00	98	8.32	6	180	25	22.40	34.88	24.03	24.14	0.1027	0.0977	390
28°	44	22.37	34.91	24.07	4.99	98	8.30	6	290	50	22.35	34.91	24.07	24.30	0.2051	0.1947	386
	68	22.38	34.85	24.02	4.96	98	8.31	6	240[d]	75	22.30	34.67	23.90	24.24	0.3092	0.2935	404
	92	20.07	34.32	24.24	5.97	113	8.26	7	680[d]	100	19.70	34.32	24.35	24.80	0.410	0.389	0.00362

[a] Temperature from pressure-thermometer and wire depth. [b] Thermometer did not function properly. [c] Value approximate. [d] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 146--Continued																	
	184	17.00	34.62	25.24	5.20	94	8.26	9	660	150	17.95	34.50	24.92	25.61	0.587	0.556	0.00308
h	277	11.43	33.97	25.91	4.51	73	8.11	93	1470	200	16.25	34.60	25.40	26.32	0.738	0.700	265
9.0	372	8.89	34.08	26.44	4.34	67	8.00	155	2380	250	12.65	34.01	25.72	26.88	0.869	0.825	235
28°	469	7.07	33.99	26.63	3.14	47	7.89	166	7350	300	10.65	33.98	26.06	27.46	0.985	0.935	204
	665	4.79	34.07	26.99	1.01	14	7.66	260	7350	400	8.30	34.05	26.50	28.39	1.176	1.118	162
										500	6.55	34.00	26.71	29.08	1.337	1.270	142
	764	4.28	34.23	27.17	0.38	5	7.60	335	6400	700	4.60	34.12	27.05	30.39	1.602	1.523	111
	1096	3.42	34.44	27.42	0.56	8	7.62	327	....	1000	3.65	34.39	27.35	32.13	1.90	1.82	083
	1650	2.47	34.54	27.58	1.33	18	7.67	302	7150	1500	2.70	34.53	27.55	34.73	2.29	2.19	065
h	2173	1.89	34.61	27.69	1.85	24	7.73	288	7050	2000	2.05	34.60	27.67	37.22	2.60	2.50	055
10.2	2665	1.67	34.63	27.72	2.38	31	....	...	....	2500	1.70	34.63	27.71	39.61	2.86	2.76	052
25°	3157	1.54	34.65	27.75	2.23	29	....	...	....	3000	1.60	34.65	27.74	41.98	3.12	3.02	049
	3610	1.50	34.66	27.76	3.11	40	7.81	237	7050	3500	1.50	34.65	27.75	44.28	3.36	3.26	050
	4069	1.51	34.65	27.75	3.11	40	....	...	....	4000	1.50	34.65	27.75	46.55	3.61	3.52	0.00051
	4486	1.55	34.65	27.75	3.40	44	7.85	234	7150								
	4716[a]	1.55	.....	.....	....	...	....	...	....								
Station 147: October 17, 1929; 27°27' N, 138°14' W; depth bottom, 4840 m; weather, bc; sea, MS; wind, S by W 2; good conditions; series not carried deeper for fear of losing water bottles on account of frayed wire; water-bottle on piano wire did not reverse at proper level or was overturned coming up, and thermometers were not locked																	
	0	23.31	35.27	24.07	4.89	98	8.26	8	400[c]	0	23.31	35.27	24.07	24.07	0.0000	0.0000	0.00386
	5	23.34	35.28	24.06	4.91	98	....	...	....	5	23.34	35.28	24.06	24.08	0.0203	0.0193	386
	24	23.31	35.31	24.09	4.83	97	....	...	....	25	23.30	35.31	24.10	24.21	0.1014	0.0964	384
	47	23.15	35.28	24.12	5.02	100	....	...	....	50	23.10	35.26	24.12	24.35	0.2022	0.1921	382
h	71	20.62	35.07	24.67	5.45	104	8.29	5	200	75	20.30	35.06	24.75	25.09	0.2951	0.2803	323
8.8	94	19.27	35.04	25.00	....	...	8.29	5	220	100	19.15	35.04	25.03	25.48	0.377	0.358	297
3°	142	18.09	35.02	25.28	5.20	96	8.26	7	220	150	17.65	35.00	25.37	26.05	0.525	0.498	266
	188	15.25	34.42	25.49	4.56	80	8.16	42	310	200	14.25	34.13	25.48	26.40	0.664	0.630	257
	235	11.89	34.07	25.91	4.78	78	8.06	92	570	250	11.15	34.06	26.04	27.21	0.785	0.744	204
	283	10.13	34.04	26.20	4.60	73	7.99	121	770	300	9.75	34.03	26.25	27.65	0.887	0.842	185
	377	8.23	33.99	26.46	4.01	61	7.89	172	1450	400	7.85	33.99	26.52	28.41	1.068	1.015	160
										500	6.05	34.05	26.82	29.20	1.222	1.160	131
	173	.....	34.74	.....	4.93	88	8.19	9	610	700	4.40	34.21	27.14	30.48	1.466	1.393	102
h	613	4.80	34.14	27.04	0.80	11	7.57	308	....	1000	3.75	34.39	27.34	32.12	1.76	1.67	084
9.8	961[b]	3.83	34.37	27.32	0.57	8	7.53	319	4950	1500	2.70	34.58	27.59	34.77	2.13	2.04	061
10°	1380[b]	2.87	34.56	27.57	1.37	18	7.63	297	6250	2000	2.10	34.60	27.66	37.21	2.44	2.34	0.00057
	1875[b]	2.23	34.59	27.65	1.70	22	7.64	279	6950[c]								
Station 148: October 19, 1929; 24°57' N, 137°44' W; depth bottom, 4835 m; weather, bc; sea, MS; wind, 2; good conditions; considerable drift to northwest; second series was delayed to avoid tangling of piano wire																	
	0	23.41	35.18	23.96	4.84	97	....	...	....	0	23.41	35.18	23.96	23.96	0.0000	0.0000	0.00396
h	5	23.43	35.22	23.99	4.84	97	....	...	....	5	23.43	35.22	23.99	24.01	0.0208	0.0197	392
8.8	23	23.41	35.14	23.94	4.84	97	....	...	....	25	23.40	35.14	23.94	24.05	0.1042	0.0988	399
15°	46	23.32	35.14	23.97	....	...	....	...	....	50	23.00	35.11	24.04	24.27	0.2080	0.1973	389
	70	20.93	34.95	24.49	....	...	....	...	....	75	20.70	34.95	24.56	24.90	0.3042	0.2887	341
	94	20.10	34.95	24.72	5.13	97	....	...	....	100	19.95	34.95	24.76	25.21	0.391	0.372	0.00323

[a] Piano wire. [b] Depths uncertain. [c] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m³	Silicate (SiO_2) mg/m³	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 148--Continued																	
	139	18.58	34.85	25.03	4.78	89	....	...	....	150	18.30	34.82	25.08	25.76	0.554	0.525	0.00293
h	185	17.65	34.73	25.17	4.44	81	....	...	....	200	17.30	34.67	25.21	26.12	0.707	0.670	284
8.8	277	11.01	33.97	26.00	4.57	73	....	...	....	250	13.95	34.05	25.48	26.64	0.849	0.805	258
15°	372	8.15	34.00	26.49	3.62	55	....	...	....	300	10.00	33.97	26.17	27.58	0.968	0.918	193
	466	6.46	34.06	26.77	2.33	34	....	...	....	400	7.60	34.02	26.59	28.48	1.149	1.092	154
										500	6.05	34.08	26.84	29.22	1.298	1.234	129
	711	4.71	34.26	27.14	0.38	5	....	...	....	700	4.75	34.25	27.13	30.47	1.541	1.467	104
h	1009	3.92	34.46	27.39	0.75	10	....	...	....	1000	3.95	34.46	27.38	32.15	1.83	1.74	080
10.9	1504	2.86	34.50	27.52	1.30	18	....	...	....	1500	2.85	34.52	27.54	34.71	2.21	2.11	066
14°	1959	2.15	34.60	27.66	1.82	24	....	...	....	2000	2.10	34.60	27.66	37.21	2.53	2.43	057
	2415	1.80	34.62	27.71	2.17	28	....	...	....	2500	1.75	34.62	27.71	39.61	2.80	2.69	0.00052
	4795[a]	1.50	.....	.....	....	...	....	...	....								
Station 149: October 21, 1929; 21°18' N, 138°36' W; depth bottom, 5320 m; weather, bcqd; sea, MC; wind, E by N 4; good conditions; piano wire fouled bottle wire just before surface; cleared all right																	
	0	23.48	35.02	23.83	4.84	97	8.34	6	440	0	23.48	35.02	23.83	23.83	0.0000	0.0000	0.00408
	5	23.50	35.03	23.83	4.85	97	....	...	....	5	23.50	35.03	23.83	23.85	0.0215	0.0204	407
	24	23.48	35.03	23.84	4.87	98	....	...	....	25	23.50	35.03	23.83	23.94	0.1076	0.1020	409
	47	23.39	35.04	23.87	4.94	99	....	...	....	50	23.30	35.04	23.90	24.13	0.2145	0.2035	403
h	71	21.72	35.04	24.35	5.21	102	8.37	...	160	75	21.40	35.03	24.42	24.76	0.3143	0.2982	354
8.8	94	20.49	34.92	24.60	5.04	96	8.38	6	200	100	20.30	34.91	24.63	25.08	0.405	0.384	335
12°	189	17.86	34.81	25.18	4.59	84	8.30	7	230	150	18.95	34.85	24.94	25.62	0.574	0.544	306
	237	13.92	34.34	25.71	4.30	73	8.21	56	510	200	17.35	34.79	25.28	26.19	0.729	0.691	277
	285	10.81	34.02	26.06	4.11	66	8.07	118	1080	250	12.75	34.21	25.85	27.01	0.860	0.815	223
	333	9.36	33.98	26.28	3.67	57	8.01	155	1200	300	10.35	33.99	26.12	27.52	0.971	0.920	197
	381	7.82	34.02	26.55	3.08	46	7.90	186	1520	400	7.70	34.02	26.57	28.46	1.156	1.097	156
										500	6.80	34.15	26.80	29.17	1.308	1.242	134
	376	8.11	33.99	26.48	3.11	47	7.90	205	1520	700	5.25	34.31	27.12	30.45	1.558	1.481	105
	470	7.12	34.12	26.73	1.18	17	7.73	257	2180	1000	4.25	34.46	27.35	32.11	1.86	1.77	084
	564	5.88	34.20	26.95	0.62	9	7.63	276	3080	1500	2.95	34.55	27.55	34.72	2.25	2.15	066
h	659	5.42	34.28	27.07	0.49	7	7.63	285	4000[b]	2000	2.15	34.58	27.64	37.18	2.57	2.46	058
10.2	944	4.40	34.44	27.32	0.60	8	7.67	288	5200	2500	1.75	34.62	27.71	39.61	2.85	2.73	0.00052
22°	1415	3.13	34.54	27.53	1.19	16	7.70	273	6500								
	1875	2.29	34.57	27.63	1.99	26	7.75	255	7250								
	2290	1.89	34.61	27.69	2.28	30	7.76	244	6670								
	2739	1.69	34.63	27.72	2.60	34	7.76	241	7250								
	5280[a]	1.53	.....	.....	....	...	....	...	....								
Station 150: October 23, 1929; 16°15' N, 137°06' W; depth bottom, 4553 m; weather, bc; sea, MC; wind, ENE 4; poor conditions; vessel heading east with westerly current; second series delayed to avoid tangling piano wire																	
	0	25.60	34.68	22.93	4.66	96	8.39	7	520	0	25.60	34.68	22.93	22.93	0.0000	0.0000	0.00494
h	6	25.61	34.66	22.92	4.63	96	8.47	10	200	5	25.60	34.66	22.92	22.95	0.0260	0.0248	495
8.9	26	25.41	34.61	22.94	4.67	96	....	...	....	25	25.45	34.61	22.93	23.04	0.1301	0.1238	495
8°	52	22.80	34.76	23.83	4.83	95	....	...	....	50	22.85	34.76	23.81	24.04	0.2494	0.2370	411
	78	20.49	34.70	24.42	5.15	98	....	...	....	75	20.55	34.70	24.41	24.75	0.3504	0.3328	355
	104	19.27	34.63	24.68	4.98	93	8.32	11	240	100	19.55	34.64	24.62	25.07	0.441	0.419	0.00336

[a] Piano wire. [b] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 150--Continued																	
	157	14.73	34.27	25.48	4.44	77	8.12	80	300	150	15.50	34.27	25.32	26.01	0.601	0.570	0.00270
h	210	11.00	34.39	26.32	1.50	24	7.85	220	1300	200	11.20	34.36	26.26	27.19	0.721	0.684	182
8.9	261	10.37	34.52	26.53	0.33	5	7.69	237	1670	250	10.50	34.49	26.48	27.65	0.811	0.769	161
8°	314	9.71	34.53	26.65	0.20	3	7.67	244	1770	300	9.90	34.53	26.62	28.02	0.894	0.847	150
	419	8.09	34.46	26.86	0.40	6	7.66	257	2080	400	8.30	34.46	26.82	28.70	1.042	0.989	132
										500	7.10	34.45	26.99	29.35	1.173	1.113	116
	401	8.19	34.46	26.84	0.65	10	7.66	257	1960	700	5.65	34.46	27.19	30.51	1.399	1.328	099
	499	7.16	34.46	26.99	0.19	3	7.65	271	2380	1000	4.25	34.53	27.40	32.16	1.68	1.60	079
	701	5.63	34.46	27.19	0.48	7	7.60	297	4050	1500	2.85	34.58	27.58	34.75	2.05	1.95	062
	1001	4.22	34.53	27.41	0.91	13	7.65	288	4550[b]	2000	2.15	34.62	27.68	37.22	2.36	2.25	055
h	1495	2.88	34.58	27.58	1.48	20	7.69	271	5880	2500	1.80	34.64	27.72	39.62	2.62	2.51	051
10.6	1977	2.14	34.62	27.68	1.85	24	7.79	257	6330	3000	1.70	34.65	27.73	41.96	2.87	2.77	0.00051
10°	2414	1.87	34.63	27.71	2.28	30	7.81	244	6580								
	2867	1.73	34.65	27.73	2.61	34	7.80	234	6250								
	3274	1.61	34.66	27.75	2.88	38	7.81	229	6500								
	4513[a]	1.44	.....	.....	....	...	....	...	....								

Station 151: October 25, 1929; 12°40' N, 137°32' W; depth bottom, 4918 m; weather, qr; sea, MS; wind, NW to NE 0-1; fair conditions; raining nearly throughout observations; salinity values by titration

	0	25.95	34.02	22.34	4.70	97	....	...	....	0	25.95	34.02	22.34	22.34	0.0000	0.0000	0.00551
	5	25.97	33.82	22.18	4.70	97	....	...	....	5	25.97	33.82	22.18	22.21	0.0293	0.0280	566
	25	21.94	34.56	23.92	5.17	101	....	...	....	25	21.94	34.56	23.92	24.03	0.1309	0.1247	401
	50	18.28	34.42	24.77	4.44	82	....	...	....	50	18.28	34.42	24.77	25.00	0.2259	0.2147	319
h	76	14.08	34.47	25.78	1.13	19	....	...	....	75	14.10	34.47	25.78	26.13	0.2976	0.2828	225
8.9	101	12.44	34.61	26.22	0.06	1	....	...	....	100	12.50	34.60	26.20	26.67	0.351	0.334	186
6°	151	11.38	34.72	26.51	0.03	0.5	....	...	....	150	11.35	34.72	26.52	27.22	0.441	0.419	155
	202	10.79	34.70	26.60	0.05	1	....	...	....	200	10.80	34.70	26.60	27.53	0.522	0.496	149
	303	9.95	34.65	26.71	0.04	1	....	...	....	250	10.35	34.68	26.66	27.83	0.599	0.568	144
	405	9.07	34.60	26.81	0.06	1	....	...	....	300	9.95	34.65	26.71	28.11	0.675	0.640	141
	506	8.09	34.54	26.92	0.16	2	....	...	....	400	9.10	34.60	26.81	28.68	0.819	0.777	133
										500	8.15	34.54	26.91	29.26	0.956	0.906	124
	671	6.26	34.47	27.12	0.47	7	....	...	....	700	6.05	34.47	27.15	30.47	1.195	1.133	103
h	860	5.10	34.50	27.29	0.38	5	....	...	....	1000	4.50	34.51	27.37	32.13	1.49	1.41	082
11.4	1142	4.01	34.51	27.42	0.93	13	....	...	....	1500	3.05	34.55	27.54	34.70	1.88	1.79	067
12°	1614	2.77	34.56	27.57	1.69	23	....	...	....	2000	2.20	34.59	27.65	37.19	2.21	2.11	0.00058
	1895	2.33	34.59	27.64	1.99	26	....	...	....								
	4878[a]	1.49	.....	.....	....	...	....	...	....								

Station 152: October 27, 1929; 10°05' N, 139°44' W; depth bottom, 4830 m; weather, bc; sea, S; wind, 0 to NE 1; poor conditions; using 2000 meters of 6 mm-wire spliced to 2000 meters of 4 mm-wire

	0	27.45	33.68	21.60	4.43	94	8.35	20	310	0	27.45	33.68	21.60	21.60	0.0000	0.0000	0.00622
h	5	27.23	33.69	21.68	4.56	96	8.43	19	560	5	27.23	33.69	21.68	21.71	0.0324	0.0309	614
11.4	24	21.30	34.50	24.05	3.89	75	8.26	28	770	25	20.50	34.50	24.27	24.38	0.1355	0.1292	368
4°	47	14.32	34.50	25.75	0.96	16	7.87	53	1520	50	14.15	34.51	25.80	26.03	0.2132	0.2027	221
	71	12.04	34.71	26.38	0.12	2	7.77	58	1540	75	12.40	34.71	26.31	26.66	0.2655	0.2522	174
	94	11.48	34.73	26.50	0.25	4	7.76	...	1750	100	11.35	34.73	26.52	26.99	0.308	0.293	0.00154

[a] Piano wire. [b] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temper- ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos- phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper- ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 152--Continued																	
	141	10.77	34.70	26.60	0.62	10	7.78	197	2040b)	150	10.70	34.70	26.61	27.31	0.388	0.368	0.00146
h	188	10.42	34.70	26.67	0.40	6	7.76	214	1740	200	10.35	34.70	26.68	27.61	0.465	0.440	141
11.4	283	9.76	34.69	26.77	0.41	6	7.76	228	1960	250	10.00	34.69	26.73	27.90	0.538	0.509	137
4°	378	9.02	34.64	26.85	0.14	2	7.71	248	1980	300	9.65	34.68	26.78	28.18	0.610	0.578	135
	472	8.32a)	34.60	26.93	0.28	4	7.71	234	2530	400	8.90	34.63	26.86	28.73	0.749	0.710	128
										500	8.10	34.59	26.95	29.30	0.881	0.834	121
h	583	7.39	34.56	27.04	0.26	4	7.71	241	2860	700	6.45	34.54	27.15	30.46	1.117	1.059	104
10.7	870	5.29	34.53	27.29	0.69	10	7.69	260	3950	1000	4.65	34.54	27.37	32.13	1.41	1.34	083
4°	1342	3.49	34.57	27.52	1.54	21	7.71	252	5620	1500	3.10	34.58	27.56	34.72	1.80	1.72	065
	1921	2.28	34.60	27.65	1.98	26	....	...	....	2000	2.15	34.61	27.67	37.21	2.11	2.02	056
										2500	1.90	34.66	27.73	39.62	2.38	2.28	051
	1977	2.18	34.62	27.68	2.08	27	7.76	217	6750	3000	1.70	34.66	27.74	41.97	2.63	2.54	050
h	2496	1.89	34.66	27.73	2.50	33	....	...	....	3500	1.55	34.66	27.76	44.29	2.87	2.79	0.00049
9.2	2948	1.73	34.66	27.74	2.71	35	7.78	218	7250								
0°	3408	1.58	34.66	27.75	2.84	37	....	...	....								
	3923	1.39	34.65	27.76	3.63	47	7.83	212	6670								
Station 153: October 29, 1929; 7°45' N, 141°24' W; depth bottom, 5003 m; weather, bc; sea, MS; wind, NE by E 3; good conditions except for heavy easterly current																	
	0	28.08	34.20	21.78	4.51	96	8.47	7	270	0	28.08	34.20	21.78	21.78	0.0000	0.0000	0.00605
	5	28.07	34.19	21.78	4.51	96	8.39	7	....	5	28.07	34.19	21.78	21.80	0.0317	0.0303	605
	24	28.12	34.20	21.77	4.31	92	8.39	7	770	25	28.10	34.20	21.78	21.89	0.1589	0.1514	606
	48	28.05	34.40	21.95	4.45	95	8.39	7	....	50	28.05	34.42	21.96	22.19	0.3157	0.3006	588
h	72	27.84	34.72	22.25	3.84	82	8.39	8	550	75	27.80	34.72	22.27	22.61	0.4666	0.4444	561
8.7	97	22.73	34.73	23.83	4.17	82	8.28	31	....	100	20.50	34.73	24.44	24.89	0.586	0.558	353
10°	144	13.51	34.54	25.95	1.39	24	7.90	154	1820b)	150	13.10	34.54	26.03	26.72	0.733	0.697	202
	193	11.16	34.67	26.50	0.36	6	7.78	202	....	200	11.00	34.67	26.54	27.47	0.828	0.787	154
	291	9.92	34.64	26.70	0.87	14	7.78	212	2270	250	10.35	34.64	26.63	27.80	0.908	0.861	147
	389	9.20	34.67	26.85	0.66	10	7.76	220	2220	300	9.90	34.64	26.71	28.11	0.984	0.934	141
	487	.....c)	34.60	.....	0.26	4d)	7.69	255	2560	400	9.10	34.66	26.86	28.73	1.126	1.069	128
										500	7.95	34.57	26.97	29.32	1.257	1.192	118
	481	8.11	34.57	26.94	0.19	3	....	...	....	700	6.00	34.47	27.16	30.47	1.490	1.412	102
h	736	5.86	34.47	27.17	0.25	4	7.64	271	3510	1000	4.65	34.56	27.39	32.14	1.78	1.69	081
10.7	1024	4.56	34.57	27.40	0.76	11	....	...	....	1500	3.10	34.60	27.58	34.74	2.16	2.05	063
15°	1501	3.10	34.60	27.58	1.56	21	7.70	255	3640	2000	2.25	34.60	27.65	37.19	2.48	2.36	058
	1957	2.30	34.60	27.65	1.86	25	....	...	....	2500	1.90	34.61	27.69	39.58	2.75	2.64	0.00055
	2397	1.93	34.61	27.69	2.41	32	7.79	230	....								
Station 154: October 31, 1929; 6°42' N, 143°22' W; depth bottom, 5149 m; weather, bc; sea, S; wind, O; practically calm; short series fouled pump wire; cleared without damage by passing line under keel																	
	0	28.34	34.18	21.69	4.42	95	8.39	7	250	0	28.34	34.18	21.69	21.69	0.0000	0.0000	0.00613
h	5	28.36	34.16	21.67	4.47	96	8.42	...	300	5	28.36	34.16	21.67	21.69	0.0323	0.0307	615
10.5	24	28.20	34.14	21.70	4.37	94	8.40	...	300	25	28.20	34.14	21.70	21.81	0.1613	0.1536	613
4°	47	28.18	34.18	21.74	4.51	97	8.40	...	260	50	28.20	34.19	21.74	21.97	0.3218	0.3063	609
	71	28.01	34.74	22.22	4.48	96	8.37	7	300	75	27.95	34.75	22.24	22.58	0.4758	0.4529	563
	94	25.81	34.82	22.98	3.49	72	7.93	21	550	100	25.30	34.82	23.13	23.58	0.612	0.583	0.00479

a) Temperature from pressure-thermometer and wire-depth. b) Value rejected. c) Thermometer did not function properly. d) Value approximate.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Continued

L.M.T. and wire angle	Observed values: Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	Interpolated values: A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Computed values: Density (σ_{tP})	Anomalies: Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 154--Continued																	
	141	16.74	34.68	25.35	2.59	46	8.06	90	1540	150	15.35	34.66	25.65	26.34	0.801	0.762	0.00239
h	188	12.03	34.59	26.29	1.61	26	7.91	149	1670	200	11.50	34.59	26.38	27.31	0.910	0.865	171
10.5	283	9.77	34.64	26.73	0.77	12	7.76	182	2080	250	10.20	34.63	26.64	27.81	0.993	0.944	146
4°	377	9.06	34.64	26.85	0.74	11	7.73	192	2080	300	9.60	34.64	26.76	28.16	1.068	1.015	137
	471	8.25	34.59	26.93	0.37	6	7.73	209	8220[a]	400	8.85	34.63	26.87	28.74	1.207	1.148	127
										500	7.95	34.57	26.97	29.32	1.338	1.270	118
	508	7.86	34.56	26.96	0.36	5	7.68	248	2530	700	6.05	34.52	27.19	30.50	1.568	1.487	099
	709	6.00	34.52	27.20	0.57	8	7.68	248	3620	1000	4.70	34.51	27.34	32.09	1.86	1.77	086
	1010	4.64	34.51	27.34	1.12	16	7.75	209	4100	1500	3.20	34.52	27.51	34.67	2.27	2.16	071
h	1462	3.30	34.52	27.50	1.69	23	7.76	228	5000	2000	2.30	34.61	27.66	37.21	2.60	2.49	057
9.0	1924	2.35	34.61	27.65	2.14	28	7.76	228	6250	2500	1.90	34.62	27.70	39.59	2.87	2.76	054
6°	2427	1.96	34.62	27.69	2.45	32	7.78	214	7350	3000	1.75	34.62	27.71	41.93	3.14	3.04	054
	2938	1.77	34.62	27.71	2.67	35	7.83	206	6950[a]	3500	1.55	34.63	27.72	44.25	3.41	3.30	0.00053
	3453	1.56	34.63	27.73	2.97	39	7.84	204	6670								
	3917	1.43	34.63	27.74	3.65	47	7.87	198	6250								
Station 155: November 2, 1929; 4°51' N, 146°46' W; depth bottom, 5304 m; weather, ou; sea, MC; wind, SSE 4; bad conditions; heavy westerly current about 75 meters deep																	
	0	27.76	34.94	22.45	4.41	94	8.29	29	310	0	27.76	34.94	22.45	22.45	0.0000	0.0000	0.00540
	3	27.77	34.94	22.45	4.42	94	8.32	...	600	5	27.75	34.94	22.45	22.47	0.0284	0.0271	540
	17	27.77	34.93	22.44	4.42	94	8.32	...	1110	25	27.75	34.93	22.44	22.55	0.1422	0.1352	542
	35	27.76	34.94	22.45	4.48	96	8.30	...	530	50	27.70	34.93	22.46	22.69	0.2845	0.2706	541
h	53	27.71	34.93	22.46	4.42	94	8.30	32	1320	75	27.35	35.00	22.63	22.97	0.4246	0.4041	526
8.7	69	27.42	34.99	22.60	4.43	94	8.30	34	1560[a]	100	27.25	35.04	22.69	23.14	0.562	0.535	521
45°	103	27.20	35.03	22.69	4.46	94	8.30	35	470	150	24.50	35.03	23.53	24.20	0.815	0.775	442
	134	26.88	35.03	22.80	4.10	86	8.30	40	980	200	13.05	34.70	26.17	27.09	0.983	0.934	191
	166	.....[c]	35.00	.....	3.98	80	8.23	50	460	250	10.95	34.68	26.55	27.72	1.074	1.020	155
	197	.....[d]	34.70	.....	2.50	47	8.05	98	890	300	10.25	34.69	26.68	28.08	1.153	1.095	144
	259	10.85	34.71	26.60	2.20	35	7.94	181	1790[a]	400	9.20	34.67	26.85	28.72	1.297	1.232	129
h										500	8.15	34.62	26.97	29.32	1.429	1.356	118
9.4	124	26.63	35.06	22.90	....	...	8.31	48	420	700	6.25	34.55	27.18	30.49	1.660	1.575	101
45°	166	19.62[e]	35.03	24.90	4.39	83	8.31	...	420	1000	4.55	34.54	27.38	32.14	1.95	1.85	082
	263	10.68	34.68	26.60	2.18	35	7.91	189	1520	1500	3.15	34.58	27.55	34.71	2.33	2.23	066
h	353	9.68	34.69	26.78	1.60	25	7.81	186	1490	2000	2.25	34.59	27.64	37.18	2.66	2.54	058
10.4	448	8.76	34.64	26.90	0.74	11	7.73	213	1960	2500	1.90	34.64	27.71	39.60	2.94	2.81	053
48°	647	6.64	34.56	27.14	0.83	12	....	...	....	3000	1.70	34.65	27.73	41.96	3.20	3.08	0.00051
	963	4.58	34.54	27.38	1.48	21	7.73	239	4270								
	1156	4.13	34.56	27.44	1.42	20	7.73	233	4500								
	1493	3.16	34.58	27.56	1.62	22	....	...	....								
h	1999	2.28	34.59	27.64	2.22	29	7.80	214	6020								
12.3	2478	1.92	34.64	27.71	2.37	31	....	...	....								
42°	2966	1.73	34.65	27.73	2.60	34	7.81	204	6670								
	5273[b]	1.44	.....	.....	....	...	....	...	....								

a) Value rejected. b) Piano wire. c) Thermometer off scale. d) Temperatures by two thermometers, 10.73° and 15.11°. e) Temperature mean of 19.39° and 19.87°.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

L.M.T. and wire angle	Observed values: Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	Interpolated values: A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Computed values: Density (σ_{tP})	Anomalies: Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 156: November 4, 1929; 3°01' N, 149°46' W; depth bottom, 4953 m; weather, bc; sea, MS; wind, SE by S 3; bad conditions; heavy cross-currents; bottle wire fouled net wire tearing off two thermometers from one water bottle and displacing another bottle; southerly current to depth of 200 meters and westerly current lower down																	
	0	27.61	35.01	22.55	4.44	95	8.34	28	250	0	27.61	35.01	22.55	22.55	0.0000	0.0000	0.00531
	4	27.61	34.97	22.52	4.47	95	....	...	....	5	27.60	34.97	22.52	22.54	0.0280	0.0267	534
h	18	27.59	34.99	22.54	4.42	94	....	...	....	25	27.50	35.02	22.59	22.70	0.1396	0.1329	528
8.7	42	27.18	35.06	22.72	2.13[c]	45[c]	....	...	....	50	27.00	35.06	22.78	23.01	0.2760	0.2626	510
32°	62	26.58	35.06	22.92	4.52	95	8.37	46	310	75	26.65	35.06	22.89	23.23	0.4089	0.3891	501
	83	26.62	35.06	22.90	4.54	95	8.34	48	450	100	26.35	35.07	23.00	23.45	0.539	0.513	492
	123	25.90	35.08	23.15	4.46	93	8.28	47	500	150	25.15	35.02	23.33	24.00	0.790	0.751	461
										200	16.15	34.89	25.64	26.56	0.976	0.927	242
	139	25.56	35.05	23.23	3.84	80	8.30	50	540	250	11.95	34.84	26.49	27.65	1.081	1.028	161
	185	.....[b]	34.91	.....	1.40	27	7.94	142	1330[c]	300	11.00	34.77	26.62	28.01	1.164	1.106	150
h	278	11.40	34.81	26.57	0.86	14	7.81	170	1390	400	9.50	34.62	26.76	28.63	1.316	1.251	139
10.6	375	9.85	34.62	26.70	0.71	11	7.75	192	1980	500	8.25	34.63	26.96	29.31	1.453	1.380	119
39°	475	8.57	34.64	26.92	0.97	15	7.76	217	2220	700	5.95	34.52	27.20	30.51	1.683	1.597	098
	683	6.07	34.53	27.19	1.10	16	7.67	241	3330	1000	4.40	34.48	27.35	32.11	1.97	1.87	084
	1020	4.31	34.48	27.36	1.80	25	7.73	239	4170	1500	3.00	34.59	27.58	34.75	2.36	2.24	063
										2000	2.30	34.63	27.67	37.21	2.67	2.55	056
	1481	3.06	34.59	27.58	1.68	23	7.73	233	5430	2500	1.85	34.63	27.70	39.59	2.94	2.81	053
h	2011	2.30	34.63	27.67	2.02	27	7.76	228	6580	3000	1.70	34.65	27.73	41.96	3.20	3.08	0.00051
11.5	2470	1.87	34.63	27.70	1.82	24	7.79	220	7250[c]								
40°	2918	1.77	34.64	27.72	1.95	26	7.81	209	6670								
	3322	1.55	34.66	27.75	2.70	35	7.81	204	6400								
	4913[a]	1.39	.....	.....	....	...	....	...	....								
Station 157: November 6, 1929; 1°48' S, 152°22' W; depth bottom, 4693 m; weather, bc; sea, MCL; wind, E 5; fair conditions																	
	0	27.08	35.25	22.89	4.47	95	8.27	47	260	0	27.08	35.28	22.89	22.89	0.0000	0.0000	0.00498
	5	27.09	35.14	22.81	4.47	95	8.39	...	520	5	27.09	35.14	22.81	22.83	0.0264	0.0251	506
	24	27.03	35.20	22.88	4.42	93	8.34	...	530	25	27.05	35.20	22.87	22.98	0.1323	0.1258	501
	48	27.03	35.24	22.91	4.57	97	8.32	60	510	50	27.05	35.24	22.90	23.13	0.2637	0.2507	498
h	72	27.04	35.32	22.96	4.39	93	8.30	64	620	75	27.05	35.33	22.97	23.31	0.3941	0.3748	494
10.0	96	26.98	35.45	23.09	....	...	8.30	64	990[c]	100	26.85	35.47	23.14	23.59	0.521	0.496	478
13°	144	20.32	35.57	25.13	3.10	59	8.16	111	420	150	19.20	35.57	25.43	26.11	0.716	0.680	260
	201	12.92	34.93	26.37	0.93	16	7.85	165	1190	200	12.95	34.93	26.36	27.28	0.831	0.790	174
	238	12.61	34.89	26.40	0.76	13	7.85	176	1250	250	12.50	34.90	26.43	27.59	0.920	0.874	167
	286	12.14	34.90	26.50	0.68	11	7.81	189	1330	300	12.00	34.90	26.53	27.92	1.007	0.956	159
	382	11.14	34.85	26.65	1.69	27	7.83	198	1300	400	10.75	34.76	26.65	28.51	1.169	1.111	149
										500	8.30	34.65	26.97	29.32	1.312	1.244	118
	402	10.66	34.74	26.65	2.10	34	7.90	192	1280	700	5.95	34.50	27.18	30.50	1.542	1.462	100
	464	8.90	34.70	26.92	0.27	4	7.73	261	2130[c]	1000	4.30	34.51	27.39	32.14	1.83	1.73	080
h	652	6.36	34.51	27.14	1.28	19	7.73	268	2500	1500	3.00	34.60	27.59	34.76	2.20	2.09	062
10.8	935	4.56	34.50	27.35	1.65	23	7.76	268	3900	2000	2.25	34.60	27.66	37.20	2.51	2.40	057
23°	1411	3.18	34.62	27.59	2.19	30	7.76	257	5440	2500	1.85	34.63	27.70	39.59	2.78	2.66	0.00053
	1878	2.40	34.58	27.62	1.84	24	7.75	251	6410								
	2318	2.00	34.62	27.69	2.18	29	7.75	245	6410								

[a] Piano wire. [b] Thermometer off scale. [c] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for *Carnegie* deep sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 158: November 8, 1929; 6°33' S, 154°58' W; depth bottom, 4065 m; weather, bc; sea, ML; wind, NE 4; fair conditions																	
	0	28.16	35.57	22.79	3.64	78	8.34	36	220	0	28.16	35.57	22.79	22.79	0.0000	0.0000	0.00508
	5	28.17	35.59	22.80	4.25	92	8.42	35	230	5	28.17	35.59	22.80	22.82	0.0267	0.0254	507
	24	28.14	35.59	22.81	3.98	86	8.34	48	220	25	28.15	35.59	22.81	22.92	0.1333	0.1268	507
	48	28.14	35.58	22.80	3.36	72	8.39	50	220	50	28.15	35.58	22.80	23.03	0.2667	0.2537	508
h	73	28.08	35.66	22.88	3.30	71	8.34	50	300	75	28.10	35.66	22.88	23.22	0.3995	0.3800	502
10.3	96	27.81	35.89	23.14	2.95	63	8.39	48	620	100	27.65	35.89	23.20	23.65	0.527	0.502	473
17°	193	19.93	35.68	25.32	2.59	49	8.20	83	660[b]	150	25.10	35.83	23.95	24.62	0.757	0.720	402
	289	12.15	34.89	26.49	1.36	23	7.94	135	760	200	18.75	35.64	25.59	26.50	0.929	0.883	248
	386	9.58	34.72	26.82	1.42	22	7.91	139	1200	250	13.85	35.14	26.34	27.50	1.040	0.989	176
	482	8.42	34.63	26.94	1.87	29	7.87	143	1370	300	11.65	34.86	26.57	27.96	1.128	1.072	156
										400	9.40	34.70	26.84	28.71	1.278	1.216	130
	472	8.31	34.62	26.95	2.14	33	7.87	149	1330	500	8.10	34.61	26.97	29.32	1.411	1.340	118
	661	6.50	34.56	27.16	1.62	24	7.77	194	2320	700	6.20	34.55	27.19	30.50	1.641	1.558	100
	941	4.69	34.52	27.35	1.92	27	7.75	213	2860	1000	4.45	34.52	27.38	32.14	1.93	1.83	081
h	1399	3.30	34.57	27.54	2.28	31	....	...	....	1500	3.05	34.59	27.57	34.74	2.31	2.20	064
8.8	1840	2.48	34.63	27.66	2.54	34	7.76	200	4850	2000	2.30	34.61	27.66	37.20	2.62	2.51	057
24°	2260	2.07	34.59	27.65	2.74	36	....	...	....	2500	1.90	34.62	27.70	39.59	2.89	2.78	054
	2727	1.75	34.66	27.74	2.78	36	7.82	186	4900	3000	1.70	34.65	27.73	41.96	3.16	3.05	051
	3188	1.67	34.67	27.75	2.86	37	....	...	....	3500	1.60	34.66	27.75	44.27	3.41	3.30	0.00050
	3645	1.57	34.65	27.74	2.77[a] 3.37	36[a] 44	7.83	177	5750[b]								
Station 159: November 11, 1929; 9°24' S, 159°01' W; depth bottom, 5545m; weather, bc; sea, MS; wind, N 3; good conditions																	
	0	28.60	35.74	22.77	3.99	87	8.37	15	670[b]	0	28.60	35.74	22.77	22.77	0.0000	0.0000	0.00510
	5	28.60	35.70	22.74	4.28	93	....	...	....	5	28.60	35.70	22.74	22.76	0.0269	0.0256	512
	25	28.53	35.72	22.78	4.09	89	....	...	....	25	28.53	35.72	22.78	22.89	0.1344	0.1278	510
	50	28.53	35.74	22.80	3.91	85	....	...	....	50	28.53	35.74	22.80	23.03	0.2682	0.2550	508
h	76	28.45	35.75	22.83	4.27	93	8.39	15	430	75	28.45	35.75	22.83	23.17	0.4016	0.3820	507
10.2	101	27.90	35.75	23.01	4.10	88	8.37	23	300	100	28.00	35.75	22.98	23.43	0.533	0.507	494
7°	152	24.92	36.14	24.25	3.31	68	8.32	29	280	150	25.10	36.14	24.19	24.86	0.762	0.725	379
	202	21.48	35.92	25.08	3.14	61	8.28	35	300	200	21.65	35.95	25.06	25.96	0.942	0.895	298
	252	16.72	35.14	25.70	....	...	8.14	90	1560[b]	250	16.85	35.14	25.67	26.82	1.083	1.029	240
	303	13.69	34.99	26.26	2.06	35	8.03	127	1720	300	13.85	35.00	26.24	27.62	1.196	1.136	188
	404	9.93	34.70	26.75	1.96	31	7.89	165	1310	400	10.00	34.71	26.75	28.62	1.368	1.300	139
										500	7.75	34.60	27.02	29.38	1.502	1.426	113
	377	10.73	34.77	26.66	2.17	35	7.89	184	1260	700	5.70	34.47	27.20	30.52	1.724	1.637	098
	473	8.27[d]	34.63	26.96	2.68	41	7.84	177	1430	1000	4.45	34.53	27.38	32.14	2.01	1.91	081
	665	5.93	34.47	27.16	2.76	40	7.81	198	2470	1500	2.85	34.57	27.58	34.75	2.38	2.27	062
h	947	4.59	34.52	27.36	2.66	37	7.76	216	3160	2000	2.15	34.58	27.64	37.19	2.70	2.57	058
9.2	1408	3.09	34.58	27.57	2.50	34	7.75	216	5150	2500	1.85	34.64	27.71	39.60	2.97	2.84	0.00052
22°	1890	2.24	34.56	27.62	2.96	39	7.79	214	6250								
	2370	1.96	34.63	27.70	3.12	41	7.78	214	6250								
	2857[c]	1.70	34.65	27.73	3.12	41	7.81	208	6270								
	5505[c]	1.34	.....	......	....	...	....	...	....								

[a] Sample contaminated with ooze. [b] Value rejected. [c] Piano wire. [d] Temperature mean of 8°.22 and 8°.32.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep-sea stations, 1928-1929--Continued

Observed values										Interpolated values				Computed values			
															Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phos-phate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temper-ature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Station 160:	November 13, 1929; 10°54' S, 161°53' W; depth bottom, 2614m; weather, oqr; sea, MS; wind, NE 3; good conditions																
	0	28.57	35.57	22.65	3.91	85	8.37	12	480[b]	0	28.57	35.57	22.65	22.65	0.0000	0.0000	0.00521
	5	28.58	35.24	22.40	4.08	89	8.44	...	300	5	28.58	35.24	22.40	22.42	0.0280	0.0267	545
	24	28.57	35.65	22.72	4.14	90	8.43	...	220	25	28.55	35.65	22.72	22.83	0.1395	0.1327	515
	48	28.58	35.62	22.68	4.11	89	8.39	...	260	50	28.55	35.62	22.70	22.93	0.2753	0.2617	517
h	74	28.26	35.68	22.84	3.75	81	8.44	...	260	75	28.25	35.68	22.84	23.18	0.4098	0.3896	506
9.5	98	28.52	35.68	22.76	4.32	94	8.44	16	630[b]	100	28.50	35.68	22.76	23.21	0.544	0.517	515
15°	147	27.98	35.82	23.04	4.24	91	8.42	19	290	150	27.80	35.83	23.10	23.76	0.806	0.766	483
	196	24.31	36.12	24.41	3.54	72	8.30	52	280	200	23.80	36.12	24.57	25.46	1.026	0.974	346
	244	20.87	35.78	25.14	3.23	62	8.23	67	270	250	20.60	35.75	25.19	26.32	1.192	1.132	287
	294	17.63	35.27	25.58	3.27	60	8.16	90	460	300	17.00	35.21	25.70	27.07	1.332	1.264	239
	392	10.82	34.67	26.57	1.84	30	7.95	159	1120	400	9.45	34.64	26.78	28.65	1.530	1.452	136
										500	7.30	34.53	27.02	29.38	1.662	1.576	112
	368	10.70	34.70	26.61	2.42	39	7.94	154	1030	700	5.65	34.46	27.19	30.51	1.885	1.787	099
	472	7.72	34.56	26.99	2.62	39	7.92	205	1520	1000	4.30	34.51	27.39	32.15	2.17	2.06	080
	652	5.91	34.46	27.16	2.49	36	7.85	216	2200	1500	2.90	34.56	27.57	34.74	2.54	2.42	063
h	939	4.54	34.49	27.34	2.54	36	7.87	229	3160	2000	2.15	34.58	27.64	37.18	2.86	2.73	058
8.6	1416	3.10	34.56	27.55	2.77	37	7.81	229	5100	2500	1.85	34.65	27.72	39.61	3.14	2.99	0.00051
22°	1885	2.31	34.56	27.62	3.01	40	7.83	221	5500								
	2359	1.90	34.65	27.72	2.70	35	7.83	214	6100								
	2574[a]	1.81	.....	.....	....	...	....	...	....								
Station 161:	November 15, 1929; 12°04' S, 164°57' W; depth bottom, 4484 m; weather, b; sea, S; wind, E 1-2; good conditions																
	0	28.72	35.51	22.56	4.08	89	8.39	23	270	0	28.72	35.51	22.56	22.56	0.0000	0.0000	0.00530
	5	28.70	35.51	22.57	4.39	95	8.39	...	240	5	28.70	35.51	22.57	22.59	0.0278	0.0265	529
	24	28.54	35.59	22.68	4.33	94	8.39	...	210	25	28.55	35.59	22.67	22.78	0.1381	0.1314	520
h	48	28.33	35.63	22.78	4.13	89	8.37	...	190	50	28.30	35.64	22.80	23.03	0.2733	0.2599	508
10.0	72	27.85	35.77	23.04	4.14	89	8.39	24	220	75	27.80	35.78	23.07	23.41	0.4037	0.3840	484
5°	96	26.44	36.01	23.68	3.84	81	8.33	23	270	100	26.00	36.03	23.83	24.28	0.521	0.496	412
	146	23.87	36.18	24.59	3.59	73	8.30	44	240	150	23.65	36.18	24.66	25.33	0.718	0.682	335
	191	21.35	35.92	25.12	3.08	60	8.23	54	200	200	20.80	35.86	25.22	26.12	0.882	0.838	283
	286	15.48	35.11	25.96	3.36	59	8.07	83	300	250	17.55	35.40	25.71	26.85	1.018	0.967	237
	382	10.41	34.68	26.65	1.97	31	7.90	145	960	300	14.60	35.00	26.08	27.45	1.135	1.077	203
										400	9.85	34.66	26.73	28.60	1.316	1.250	141
	471	8.14	34.59	26.95	2.74	43	7.84	181	1310	500	7.55	34.56	27.01	29.37	1.452	1.377	114
	670	5.58	34.47	27.21	3.18	46	7.81	201	1940	700	5.40	34.47	27.23	30.56	1.671	1.585	094
	967	4.41	34.49	27.36	2.85	40	7.80	218	3160	1000	4.30	34.50	27.38	32.14	1.95	1.85	081
	1468	2.94	34.56	27.56	2.96	40	....	...	....	1500	2.85	34.56	27.57	34.74	2.33	2.21	063
h	1971	2.14	34.59	27.65	3.30	44	7.78	214	5440	2000	2.15	34.59	27.65	37.20	2.64	2.52	058
8.7	2418	1.90	34.64	27.71	3.20	42	....	...	....	2500	1.85	34.64	27.71	39.60	2.91	2.79	052
9°	2898	1.72	34.66	27.74	3.21	42	7.76	209	6250	3000	1.70	34.66	27.74	41.97	3.17	3.05	050
	3386	1.59	34.68	27.77	3.48	45	....	...	....	3500	1.60	34.67	27.76	44.28	3.42	3.30	049
	3919	1.44	34.67	27.77	3.87	50	7.80	198	5500	4000	1.40	34.68	27.78	46.59	3.66	3.54	0.00047
	4444[a]	1.09	.....	.....	....	...	....	...	....								

[a] Piano wire. [b] Value rejected.

Table 2--Physical and chemical data and results of dynamic computations for Carnegie deep sea stations, 1928-1929--Concluded

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies: Pressure (ΔP)	Anomalies: Dynamic depth (ΔD)	Anomalies: Specific volume ($\Delta\alpha$)
Station 162: November 17, 1929; 13°36' S, 168°23' W; depth bottom, 5124 m; weather, b; sea, S; wind, 0; good conditions; large difference in temperatures for surface and 5 meters probably due to four calm days and no mixing of surface layers																	
	0	28.62	35.27	22.42	3.65	79	8.39	11	230	0	28.62	35.27	22.42	22.42	0.0000	0.0000	0.00543
	5	27.88	35.32	22.70	4.20	90	8.35	...	210	5	27.88	35.32	22.70	22.72	0.0279	0.0265	516
	24	27.38	35.61	23.07	4.42	94	8.47	...	210	25	27.35	35.61	23.09	23.20	0.1331	0.1261	480
	47	26.77	35.85	23.46	4.25	90	8.39	...	240	50	26.70	35.85	23.48	23.71	0.2545	0.2415	443
h	71	26.20	35.86	23.64	4.20	88	8.39	...	200	75	26.10	35.86	23.67	24.01	0.3689	0.3503	427
9.2	94	25.61	35.84	23.81	4.40	91	8.39	11	250	100	25.45	35.85	23.87	24.32	0.478	0.455	409
0°	141	24.20	36.12	24.45	3.30	67	8.32	17	230	150	23.85	36.10	24.54	25.21	0.677	0.643	346
	188	21.90	35.72	24.81	3.52	69	8.32	21	200	200	21.35	35.71	24.96	25.86	0.850	0.808	308
	235	19.97 [b]	35.68	25.30	3.30	63	8.29	23	220	250	19.30	35.61	25.43	26.56	1.001	0.950	264
	283	.....	35.37	.....	3.49	63	8.18	70	260	300	16.65	35.13	25.71	27.08	1.134	1.076	238
	377	11.73	34.65	26.38	2.88	47	7.99	123	660	400	10.70	34.63	26.56	28.43	1.342	1.274	158
										500	8.00	34.53	26.92	29.27	1.491	1.414	122
	396	10.94	34.67	26.55	2.71	44	7.95	165	910	700	5.45	34.40	27.17	30.50	1.726	1.637	101
	500	8.03	34.53	26.92	2.91	44	7.83	189	1300	1000	4.10	34.48	27.38	32.14	2.01	1.91	081
	718	5.32	34.40	27.18	3.19	45	7.83	202	2440	1500	2.85	34.57	27.58	34.75	2.39	2.27	062
h	998	4.11	34.48	27.38	3.11	43	7.81	209	3030	2000	2.20	34.58	27.64	37.18	2.71	2.58	058
8.4	1490	2.85	34.59	27.59	3.09	42	7.79	212	4550	2500	1.85	34.63	27.70	39.59	2.98	2.85	0.00053
0°	1972	2.23	34.57	27.63	3.08	41	7.80	205	5100								
	2452	1.89	34.63	27.71	2.95	39	7.81	202	5690								
	5084 [a]	1.08	.....	.....	....	...	....	...	....								

[a] Piano wire. [b] Thermometer did not function properly.

Table 2a--Physical data and results of dynamic computations from observations in the Gulf of Alaska, January and February 1929, by the International Fisheries Commission and supplied by the Scripps Institution of Oceanography

Observed values										Interpolated values				Computed values			
					Oxygen										Anomalies		
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	ml/L	o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Pressure (ΔP)	Dynamic depth (ΔD)	Specific volume ($\Delta\alpha$)
Group I (station Nos. 9, 11, 12) January 1929; 57°31' N, 141°57' W																	
	0	5.23	32.54	25.72						0	5.23	32.54	25.72	25.72	0.0000	0.0000	0.00228
	25	5.00	32.57	25.77						5	5.10	32.54	25.73	25.75	0.0120	0.0114	227
	50	5.30	32.61	25.77						25	5.00	32.57	25.77	25.89	0.0596	0.0565	224
	100	5.10	33.04	26.13						50	5.30	32.61	25.77	26.02	0.1185	0.1125	224
	200	3.97	33.86	26.91						75	5.26	32.82	25.94	26.30	0.1754	0.1666	208
	300	3.77	34.00	27.03						100	5.10	33.04	26.13	26.61	0.228	0.216	190
	400	3.77	34.05	27.07						150	4.50	33.56	26.61	27.33	0.317	0.300	145
	500	3.67	34.16	27.17						200	3.97	33.86	26.91	27.87	0.386	0.366	117
	600	3.60	34.23	27.23						250	3.83	33.95	26.99	28.19	0.446	0.422	110
	700	3.27	34.27	27.30						300	3.88	34.00	27.03	28.47	0.503	0.477	107
	800	3.30	34.33	27.34						400	3.77	34.05	27.07	29.00	0.614	0.584	106
	900	3.07	34.36	27.39						500	3.67	34.16	27.17	29.58	0.719	0.685	096
	1000	2.90	34.40	27.44						700	3.27	34.28	27.30	30.66	0.907	0.866	085
	1200[a]	2.6	34.43	27.48						1000	2.90	34.40	27.44	32.25	1.15	1.10	071
	1300[b]	2.5	34.47	27.52						1500	2.35	34.54	27.60	34.79	1.49	1.43	0.00059
	1400[a]	2.4	34.51	27.57													
Group II (station Nos. 106, 107) January 1929; 59°15' N, 147°16' W																	
	0	5.78	32.16	25.37						0	5.78	32.16	25.37	25.37	0.0000	0.0000	0.00262
	25	5.98	32.23	25.39						5	5.82	32.17	25.36	25.38	0.0138	0.0132	263
	50	6.30	32.36	25.45						25	5.98	32.23	25.39	25.51	0.0689	0.0655	260
	100	5.95	32.52	25.62						50	6.30	32.36	25.45	25.69	0.1367	0.1297	254
	200	5.84	33.53	26.43						75	6.15	32.44	25.54	25.89	0.2029	0.1923	246
	300	4.84	33.89	26.83						100	5.95	32.52	25.62	26.09	0.267	0.253	239
	400	4.22	33.98	26.96						150	5.90	33.10	26.08	26.80	0.381	0.361	195
	500	3.95	34.07	27.07						200	5.84	33.53	26.43	27.39	0.477	0.451	164
	600	3.80	34.14	27.14						250	5.40	33.77	26.67	27.87	0.556	0.527	141
	700	3.58	34.25	27.25						300	4.84	33.89	26.83	28.27	0.627	0.594	127
	800	3.45	34.29	27.29						400	4.22	33.98	26.96	28.89	0.753	0.716	116
	900	3.25	34.34	27.35						500	3.95	34.07	27.07	29.48	0.868	0.827	106
	1000	3.16	34.40	27.41						700	3.60	34.25	27.25	30.61	1.071	1.024	091
	1200	2.72	34.47	27.51						1000	3.10	34.40	27.42	32.21	1.33	1.27	074
	1400	2.42	34.49	27.55						1500	2.30	34.49	27.56	34.75	1.69	1.62	0.00063
Group III (station Nos. 108, 109, 110, 111) January 1929; 57°42' N, 146°38' W																	
	0	5.15	32.38	25.60						0	5.15	32.38	25.60	25.60	0.0000	0.0000	0.00240
	25	5.30	32.50	25.68						5	5.18	32.40	25.61	25.63	0.0126	0.0120	239
	50	5.22	32.56	25.74						25	5.30	32.50	25.68	25.80	0.0623	0.0591	232
	100	5.42	33.24	26.25						50	5.22	32.56	25.74	25.99	0.1227	0.1163	226
	200	4.79	33.89	26.84						75	5.32	32.92	26.01	26.37	0.1792	0.1700	202
	300	4.11	33.96	26.97						100	5.42	33.24	26.25	26.73	0.229	0.217	179
	400	3.94	34.07	27.07						150	5.15	33.70	26.64	27.36	0.314	0.297	142
	500	3.83	34.13	27.13						200	4.79	33.89	26.84	27.80	0.385	0.365	125
	600	3.62	34.22	27.22						250	4.40	33.93	26.91	28.11	0.448	0.425	118
	700	3.43	34.25	27.27						300	4.11	33.96	26.97	28.41	0.509	0.483	114
	800	3.30	34.33	27.34						400	3.94	34.07	27.07	29.00	0.623	0.594	106
	900	3.18	34.36	27.39						500	3.83	34.13	27.13	29.54	0.729	0.697	100
	1000	2.91	34.40	27.44						700	3.45	34.25	27.26	30.62	0.925	0.887	090
	1200	2.65	34.43	27.48						1000	2.95	34.40	27.43	32.23	1.18	1.13	072
	1400	2.39	34.49	27.55						1500	2.25	34.53	27.59	34.78	1.53	1.47	0.00060

[a] Station 12 only. [b] Station 9 only.

Table 2a--Physical data and results of dynamic computations from observations in the Gulf of Alaska, January and February 1929, by the International Fisheries Commission and supplied by the Scripps Institution of Oceanography

Observed values										Interpolated values				Computed values			
L.M.T. and wire angle	Depth (D) meters	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Oxygen ml/L	Oxygen o/o	Hydrogen ion (pH)	Phosphate (PO_4) mg/m^3	Silicate (SiO_2) mg/m^3	A	Temperature (t) °C	Salinity (S) o/oo	Density (σ_t)	Density (σ_{tP})	Anomalies Pressure (ΔP)	Anomalies Dynamic depth (ΔD)	Anomalies Specific volume ($\Delta \alpha$)
Group IV (station Nos. 112, 113, 114, 115) January 1929; 56°18' N; 145°46' W																	
	0	4.68	32.65	25.87						0	4.68	32.65	25.87	25.87	0.0000	0.0000	0.00214
	25	4.75	32.66	25.87						5	4.69	32.65	25.87	25.89	0.0113	0.0107	214
	50	4.78	32.66	25.87						25	4.75	32.66	25.87	25.99	0.0565	0.0536	214
	100	4.79	33.28	26.36						50	4.78	32.66	25.87	26.12	0.1129	0.1070	214
	200	4.17	33.96	26.97						75	4.78	32.92	26.07	26.43	0.1670	0.1584	196
	300	3.78	34.04	27.06						100	4.79	33.28	26.36	26.84	0.215	0.204	169
	400	3.69	34.11	27.13						150	4.50	33.76	26.77	27.49	0.293	0.278	130
	500	3.61	34.18	27.19						200	4.17	33.96	26.97	27.93	0.358	0.340	112
	600	3.46	34.25	27.26						250	3.90	34.00	27.02	28.22	0.415	0.394	107
	700	3.32	34.31	27.33						300	3.78	34.04	27.06	28.50	0.471	0.447	105
	800	3.18	34.34	27.36						400	3.69	34.11	27.13	29.06	0.577	0.550	099
	900	3.02	34.38	27.41						500	3.61	34.18	27.19	29.60	0.678	0.646	093
	1000	2.85	34.43	27.46						700	3.32	34.31	27.33	30.69	0.861	0.821	082
	1200	2.59	34.47	27.52						1000	2.85	34.43	27.46	32.26	1.10	1.05	070
	1400	2.34	34.49	27.57						1500	2.25	34.50	27.57	34.77	1.44	1.39	0.00062
Group V (station Nos. 207, 208, 209) February 1929; 56°29' N, 150°06' W																	
	0	4.53	32.65	25.88						0	4.53	32.65	25.88	25.88	0.0000	0.0000	0.00213
	25	4.40	32.74	25.97						5	4.51	32.68	25.91	25.93	0.0112	0.0106	210
	50	4.33	32.77	26.01						25	4.40	32.74	25.97	26.09	0.0550	0.0521	205
	100	4.33	32.90	26.11						50	4.33	32.77	26.01	26.26	0.1084	0.1029	201
	200	4.00	33.89	26.93						75	4.33	32.82	26.04	26.40	0.1610	0.1530	199
	300	3.67	34.04	27.07						100	4.33	32.90	26.11	26.59	0.212	0.202	192
	400	3.60	34.07	27.11						150	4.18	33.44	26.55	27.27	0.303	0.287	151
	500	3.50	34.14	27.17						200	4.00	33.89	26.93	27.89	0.374	0.354	115
	600	3.37	34.23	27.25						250	3.83	34.00	27.03	28.24	0.432	0.409	106
	700	3.23	34.31	27.33						300	3.67	34.04	27.07	28.51	0.487	0.462	104
	800	3.10	34.33	27.36						400	3.60	34.07	27.11	29.04	0.593	0.565	102
	900	3.10	34.40	27.42						500	3.50	34.14	27.17	29.58	0.696	0.664	095
	1000	2.77	34.43	27.47						700	3.23	34.31	27.33	30.69	0.881	0.841	082
	1200	2.47	34.45	27.51						1000	2.80	34.43	27.46	32.27	1.12	1.07	070
	1400	2.27	34.49	27.56						1500	2.15	34.51	27.59	34.78	1.46	1.40	0.00060

Table 3. Synoptic table of bottom samples collected

For discussion see footnotes on

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1928	° ′			
10	37	Nov. 1	5 59 N 82 56 W 3324 m	Green (coprolitic) mud	3; acid soluble CaO	(Wet) grayish-olive 21^4(O-YY) Sandy clay (U.S.B.S. class = clay); rounded grains; moderately coherent, slippery, granular
11	40	8	1 32 S 82 16 W 1344 m	Volcanic gravel	5; inspection	(Dry) from near deep mouse-gray 15^5i(Y-O) to pinkish-buff 17^2d(O-Y) Angular rock fragments; (Wentworth class = sandy gravel)
12	42	13	1 32 S 93 10 W 3539 m	Siliceous globigerina ooze ?	30; inspection	(Dry) tilleul-buff 17^3f(O-Y) Clay; few shells of foraminifera; slightly coherent, pulverulent
13	43	15	2 30 S 95 43 W 3352 m	Siliceous globigerina ooze	67; total CO_2	(Moist) buffy-brown 17^3i(O-Y) Sandy clay (U.S.B.S. class = clay); small shells of foraminifera; moderately coherent, slightly plastic, crumbly, granular
14	44	17	3 15 S 99 48 W 3423 m	Siliceous globigerina ooze	76; acid soluble CaO	(Moist) between sayal-brown and tawny-olive 16^2i(Y-O, O-Y) Sandy clay (U.S.B.S. class = clay); small shells of foraminifera; moderately coherent, slightly plastic, crumbly, granular
15	46	21	9 06 S 108 20 W 2905 m	Volcanic globigerina ooze	80; inspection	(Wet) avellaneous 17^3b(O-Y) Silty sand; small shells of foraminifera; incoherent, granular
16	47	23	14 07 S 111 50 W 3080 m	Ferruginous globigerina ooze	87; acid soluble CaO	(Dry) Saccardo's umber 17^2k(O-Y) Clayey sand (U.S.B.S. class = clay); small shells of foraminifera; slightly coherent, crumbly
17	49	27	23 16 S 114 45 W 3098 m	Ferruginous (volcanic) globigerina ooze	74; acid soluble CaO	No material available as entire sample was used in mechanical analysis. (U.S.B.S. class = clay)

Sample 10. Contains over 5 per cent organic matter, nearly 2 per cent MnO_2, and relatively high ZrO_2. Constituent particles of sand size include abundant dark grayish-green elongated ellipsoidal aggregates about 0.3 mm in diameter, probably coprolitic pellets (see Murray and Philippi, 1908, p. 103, pl. XX, and Moore, 1933, p. 24); together with a few broken pelagic and bottom foraminifera, echinoid spines, abundant radiolaria, sponge spicules, very common manganese grains, brown mica (-2E large), quartz, green-brown hornblende, augite, epidote, plagioclase feldspar, basic volcanic glass, and small rhombohedral calcite crystals.

Sample 11. Consists principally of angular fragments of altered volcanic material and iron concretions greater than 0.5 and less than 8 mm in diameter, partly encrusted with worm tubes; together with a few pelagic foraminifera, sponge spicules, wood fibers, but no mud.

Sample 12. Contains abundant fragments of radiolarian skeletons, diatom frustules, and sponge spicules in addition to foraminifera, but only small amounts of clay minerals.

on cruise VII of the Carnegie in the Pacific

each page under sample number

Sampler and container used	Field notes	Nearest previous samples
Ross snapper; 18-oz. bottle	Black mud in Ross snapper, top of Nansen bottle, and in lower end of 80-lb. weight. Sample smelled strongly of oil	Albatross 4631 (p. 41); 06° 26′ N, 81° 49′ W; 776 fathoms. Green mud, $CaCO_3$ = 25.2 per cent; containing rock fragments, casts of foraminifera, echinoid spines, sponge spicules, glauconitic grains, a little quartz
Ross snapper; vial	Small amount of black gravel in Ross snapper. Hard bottom	None
Ross snapper; vial	Ross snapper failed to shut, but small sample adhered to jaws	Albatross 4521 (p. 64); 02° 14.3′ S, 92° 29.9′ W; 1871 fathoms. Globigerina ooze, $CaCO_3$ = 45 per cent. Mostly broken pelagic and many benthonic foraminifera, gray clay residue containing many fragments of siliceous organisms and minute minerals, including augite, and a little manganese and hematite
Ross snapper; 18-oz. bottle	Good bottom sample	Albatross 4523 (p. 65); 03° 34′ S, 95° 35.4′ W; 2031 fathoms. Globigerina ooze, $CaCO_3$ = 55.9 per cent. Light gray, flocculent residue, almost entirely fragments of siliceous organisms, little clay, few minerals
Ross snapper; 18-oz. bottle	Good bottom sample. Red clay and globigerina ooze	Albatross 4717 (p. 65); 05° 10′ S, 98° 56′ W; 2153 fathoms. Globigerina ooze, $CaCO_3$ = 60.3 per cent. Rich brown, very flocculent clay residue, many fragments of siliceous organisms, few minerals, coccoliths
Ross snapper; 3 vials	Ross snapper closed, but brought up only small sample. Small particles of volcanic rock in lead weight	Albatross 4723 (p. 75); 10° 14.3′ S, 107° 45.5′ W. Depth? Globigerina ooze; washed sample, $CaCO_3$ not determined. Principally pelagic forams, etc., containing few manganese grains, angular augite grains, splinters of volcanic glass
Ross snapper; 18-oz. bottle		Albatross 4726 (p. 67); 12° 30.1′ S, 111° 42.2′ W. 1700 fathoms. Globigerina ooze, $CaCO_3$ = 68 per cent. Pelagic and few benthonic foraminifera, brown clay residue very rich in manganese and limonite grains. Few remains of diatoms and sponge spicules. Minute mineral particles
Ross snapper; 2 vials and 18-oz. bottle	Ross snapper with 98-lb. lead weight on shaft let down on end of 4-mm wire, 50 m below Nansen water bottle. When hauled in, Nansen bottle was full of	None

Sample 13. Abundant fragments of radiolarian skeletons and diatom frustules occur in sand grades, in addition to predominant amounts of broken pelagic and benthonic foraminifera; also present are arenaceous foraminifera, echinoid spines, sponge spicules, and brown mica.

Sample 14. Sand grades contain smaller amounts of remains of siliceous organisms than sample 13, and correspondingly larger amounts of pelagic and some benthonic foraminifera, also present are echinoid spines, gastropod shell, and a few disk-shaped and ellipsoidal pellets.

Sample 15. Appears to be partly washed. Contains angular cinder of altered basic volcanic rock, 1 cm in longest diameter, coated with manganese; also small fragments of volcanic glass and shells of bryozoa, in addition to predominant amounts of pelagic foraminifera and a few remains of siliceous organisms.

Sample 16. Sand and coarse silt grades consist almost entirely of unbroken pelagic and a very few benthonic foraminifera, together with numerous minute manganese grains less than 0.01 mm in diameter. Diatoms, radiolaria, etc., are scarce.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1928	° ′			
18	51	Dec. 1	29 06 S 114 48 W 2898 m	Globigerina ooze	94; acid soluble CaO	(Wet) near vinaceous-buff $18^{2-1/2}d$(O-Y) Clayey sand (U.S.B.S. class = clay); moderately coherent, granular
19	52	3	31 28 S 112 51 W 2851 m	Ferruginous globigerina ooze	86; acid soluble CaO	(Wet) buffy-brown 17^3i(O-Y) Sandy clay (U.S.B.S. class = clay); shells of foraminifera; moderately coherent, sticky, granular
20	54	14	29 17 S 108 54 W 3061 m	Globigerina ooze	Top 76, bottom 80; total CO_2	Top: (moist) olive-brown 17^3k(O-Y); bottom: (moist) olive-brown 17^3k(O-Y) Sandy clay; shells of foraminifera; (top, U.S.B.S. class = clay; bottom, U.S.B.S. class = silty clay loam)
21	57	20	33 59 S 106 43 W 3139 m	Ferruginous globigerina ooze	84; acid soluble CaO	(Dry) avellaneous 17^3b(O-Y) Sandy clay (U.S.B.S. class = clay); small shells of foraminifera; slightly coherent, crumbly
22	59	24	39 51 S 101 04 W 4116 m	Ferruginous globigerina ooze	42; acid soluble CaO	(Wet) between Brussels brown and raw umber 16 m(Y-O,O-Y) Sandy clay (U.S.B.S. class = clay); small shells of foraminifera, and aggregates of fine material; coherent
23	60	26	40 24 S 97 33 W 4007 m	Globigerina ooze	75; acid soluble CaO	(Dry) avellaneous 17^3b(O-Y) Sandy clay (U.S.B.S. class = clay); shells of foraminifera; when

Sample 17. Sand grades consist largely of unbroken pelagic foraminifera, together with manganese grains and small volcanic glass shards, whereas silt grade contains very abundant small manganese and iron hydroxide grains. Sample also contains fragments several cm in diameter of a black, slightly vesicular, very brittle basic glass exhibition conchoidal fracture. These appear to have been thickly coated with manganese only on one side, indicating the top of a submarine lava flow. There are numerous cracks lined with orange and greenish palagonitic material containing phillipsite crystals. The glass itself (see plate XIII) is very fresh and unaltered, containing microscopic glomeroporphyritic clusters of basic plagioclase feldspar, small, euhedral partially altered olivine crystals, wedge and triangular shaped titanite, twinned alteration products, and augite. The relatively low content of alkalies shown by chemical analysis indicates that this rock is a member of the circum-Pacific suite, as contrasted with the rocks of Tahiti and other Pacific islands which are alkaline.

Sample 18. Sand grades consist almost entirely of unbroken pelagic foraminifera together with traces of echinoid spines, ostracod shells, benthonic foraminifera. Clay grade makes up nearly 60 per cent of sample, consists largely of finely divided calcium carbonate, with a few coccoliths.

Sample 19. Sand grades consist principally of light brownish-colored pelagic foraminifera, almost entirely unbroken, and a few benthonic foraminifera, together with pink and black irregularly shaped grains of organic (?) origin, echinoid spines, ostracod shells, and sponge spicules, one light gray fragment of acid pumice, and manganese grains.

Sampler and container used	Field notes	Nearest previous samples
	muddy water, and left-hand thermometer and brass tube were missing. End of wire for 4 m was torn and chafed, showing it had been caught in crevice on bottom. Snapper jaws badly bent at end, and fragments of black manganese-coated obsidian were mixed with globigerina ooze. Snapper fairly full	
Ross snapper; vial and 18-oz. bottle		None
Ross snapper; 2 vials and 18-oz. bottle	Brown chocolate clay and sand	None
Meteor tube; 2 vials	Used Meteor tube-sampler for first time. Got 24-in. sample with water in top of glass tube (only vial of top of section and vial of bottom of section saved)	Albatross 4517 (p. 56); 25° 50.9′ S, 109° 12.5′ W. 1723 fathoms. $CaCO_3$ = 63.55 per cent. Many species of pelagic forams, numerous small individuals. Augite, magnetite, microlites of basic plagioclase, dark brown clay with minute mineral particles
Ross snapper; vial and 18-oz. bottle	Good bottom sample. Hard reddish-brown clay-mud	None
Ross snapper; vial and 18-oz. bottle	Snapper no. 3 had not closed, but stiff red clay stuck to inside of both jaws. Good sample	None
Ross snapper; vial and 18-oz. bottle	Red clay	Challenger 294 (p. 128); 39° 22′ S, 98° 46′ W. 2270 fathoms. Red clay; $CaCO_3$ = trace (more $CaCO_3$ in lower part of core). Pelagic foraminifera and coc-

Sample 20. (Top) In addition to pelagic foraminifera, very few of which are broken, there are a few flakes of plant material and echinoid spines in sand grades. Silt grades contain numerous manganese-iron grains. (Bottom) Same as top of core.

Sample 21. Contains more broken pelagic foraminifera than last sample. Benthonic foraminifera are common (Cassidulina fava noticeable). A few flakes of plant material, manganese grains, sponge spicules, echinoid spines, ostracod tests are present. Some of pelagic foraminifera, notably Globigerina truncatulinoides, exhibit recrystallization.

Sample 22. Very high in manganese, iron, and phosphate. Contains relatively more benthonic foraminifera than any other sample except no. 31. Most of pelagic foraminifera are broken. Numerous manganese grains are present in sand grades, in addition to radiolaria, twinned crystals of phillipsite, euhedral crystals of magnetite, plagioclase feldspar and basaltic hornblende, also many ellipsoidal and flat pellets, possibly formed in mechanical analysis. Fine material is very difficult to disperse. Manganese grains contain as nuclei aggregates of white, acid volcanic glass shards (index of refraction about 1.50).

Sample 23. Large proportion of pelagic foraminifera are broken, some exhibit recrystallization. Benthonic foraminifera and manganese grains are abundant in sand grades, also present are sponge spicules, echinoid spines, ostracods, white vesicular pumice, subrounded, polished quartz grains, and greenish fine-grained mica schist fragments. Manganese grains contain nuclei of acid volcanic glass.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1928	° ′			moist, coherent and plastic; when dry, moderately coherent and crumbly
24	61	Dec. 28	38 29 S 94 14 W 3299 m	Globigerina ooze	86; total CO_2	(Moist) avellaneous 17^3b(O-Y) Sandy silt; (U.S.B.S. class = clay loam); shells of foraminifera and manganese nodules up to 1 cm; slightly coherent, crumbly
25	62	30	34 35 S 91 52 W 3610 m	Ferruginous globigerina ooze	74; acid soluble CaO	(Dry) avellaneous 17^3b(O-Y); (wet) Saccardo's umber 17^2k(O-Y) Sandy clay (U.S.B.S. class = clay); shells of foraminifera; coherent, brittle
		1929				
26	63	Jan. 1	32 10 S 89 04 W 3393 m	Globigerina ooze	91; acid soluble CaO	(Moist) between wood-brown and buffy-brown 17^3h(O-Y) Clayey sand (U.S.B.S. class = clay loam); shells of foraminifera; moderately coherent, crumbly, granular
27	64	3	31 54 S 88 17 W 3879 m	Globigerina ooze	43; acid soluble CaO	(Dry) between cinnamon-brown and Saccardo's umber $16^{1-1/2}k$(Y-O) Sandy clay (U.S.B.S. class = silt loam); small shells of foraminifera; coherent, brittle
28	65	5	31 07 S 86 39 W 3626 m	Globigerina ooze	66; total CO_2	(Dry) vinaceous-buff 17^3d(O-Y) Sand (U.S.B.S. class = fine sand); shells of foraminifera; slightly coherent, crumbly
29	67	8	24 57 S 82 15 W 1089 m	Globigerina ooze	94; acid soluble CaO	(Dry) light pinkish-cinnamon 15^2d(Y-O) (Moist) Sand (U.S.B.S. class = fine sandy loam); shells of foraminifera; slightly coherent, crumbly
30	68	10	21 28 S 80 26 W 4156 m	Red clay	3; total CO_2	(Wet) raw umber 17 m(O-Y) Sandy clay; shells of foraminifera and angular mineral grains, plastic, greasy feel

Sample 24. Contains abundant irregularly shaped manganese grains and nodules up to 6 mm in largest diameter. The silt grade consists largely of broken pelagic foraminifera, with only a small proportion of manganese grains, hence is very light in color when compared with the silt grades of samples 20 to 23.

Sample 25. Sand grades consist largely of pelagic foraminifera, many broken, some exhibiting recrystallization; benthonic foraminifera are common, manganese grains, echinoid spines, sponge spicules, and ostracods are rare. Phillipsite in small, twinned crystals, cloudy plagioclase feldspar, chlorite palagonite, and altered volcanic glass are also present in sand grades.

Sample 26. Many pelagic foraminifera are broken, some exhibit recrystallization; benthonic foraminifera are fairly common (<u>Cassidulina</u> <u>fava</u> noticeable); sand grades also contain manganese grains, radiolaria, sponge spicules, echinoid spines, and ostracod tests.

Sample 27. Sample is very high in manganese, iron, and phosphate. Benthonic foraminifera are extremely abundant. Practically all pelagic foraminifera are broken, and many exhibit recrystallization. Manganese grains are not so abundant as in sample 22 but contain as usual nuclei of acid volcanic glass. About half of sand grades consist of ellipsoidal or ovoid pellets, 0.1 mm to 1 mm in diameter, possibly formed

on cruise VII of the Carnegie in the Pacific--Continued

Sampler and container used	Field notes	Nearest previous samples
		coliths; numerous manganese particles, some phillipsite and fragments of palagonite, also feldspar, augite, quartz, magnetite, volcanic glass. Dark chocolate-colored clay, 97 per cent
Ross snapper; vial and 18-oz. bottle	Small amount of gray sand in snapper; apparently hard bottom. Jaws had not penetrated far. Slight trace of black substance on edge of jaws	Challenger 295 (p. 130); 38° 07′ S, 94° 04′ W. 1500 fathoms. $CaCO_3$ not determined, globigerina ooze. Contains pelagic and benthonic foraminifera, pteropods, ostracods, echinoid spines, cephalopod beaks, siliceous organisms, many particles of manganese, black volcanic glass and augite andesite
Ross snapper; 18-oz. bottle and vial	Red clay and sand	None
Ross snapper; 18-oz. bottle and vial	Sample gray sand; soft; snapper V_3 full	None
Ross snapper; 18-oz. bottle and 2 vials	Good sample. Red clay, mud, and ooze	None
Ross snapper; vial	Snapper did not close, spring too tight, but small amount of chocolate-red clay was brought up	None
Ross snapper; 18-oz. bottle and vial	Good sample. Gray-white sand, globigerina ooze	None
Sigsbee tube; 18-oz. bottle and 2 vials	Chocolate mud	None

in mechanical analysis, since fine material is very difficult to disperse. Sample contains much phillipsite, also plagioclase feldspar and serpentine (?).

Sample 28. Coarse sand grades consist largely of broken fragments of pelagic foraminifera, with relatively small proportion of unbroken shells, together with numerous benthonic foraminifera, fairly common manganese grains and plant material, rare echinoid spines, sponge spicules and ostracods. Twinned crystals and aggregates of phillipsite are very common in fine sand and silt grades. Finer material is quite flocculent.

Sample 29. Sand grades consist almost entirely of unbroken shells of pelagic foraminifera, some stained yellowish brown; together with rare benthonic foraminifera (the shells of arenaceous species consist of broken pelagic shells), ostracods, calcareous algae, bryozoa, unidentified remains of calcareous organisms, and fragments of crustacea. Silt and clay grades are very small in amount.

Sample 30. Sand grades consist principally of rounded and angular aggregates of fine material; also common manganese and palagonite grains, some broken shells of pelagic foraminifera, and rare flakes of muscovite and biotite.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1929	° ′			
31	69	Jan. 12	16 49 S 78 39 W 3657 m	Siliceous (calcareous) red clay	20; total CO_2	(Moist) buffy-brown 17^3i(O-Y) Clay (U.S.B.S. class = clay); few small shells of foraminifera; coherent, moderately plastic
32	70	13	13 53 S 77 54 W 4742 m	Green diatom mud	<1; total CO_2	(Dry) smoke-gray 21^4d(O-YY) Clayey silt (U.S.B.S. class = sand); moderately coherent, brittle
33	71	Feb. 6	11 57 S 78 37 W 3357 m	Green silty mud	<1; inspection	(Dry) pale smoke-gray 21^4f(O-YY) Silty clay; moderately coherent, crumbly, slightly gritty
34	72	8	9 58 S 82 10 W 4480 m	Green clayey mud	0.25; acid soluble CaO	(Moist) smoke-gray 21^4b(O-YY) Clay (U.S.B.S. class = clay); coherent, brittle
35	74	12	11 00 S 87 24 W 4141 m	Siliceous red clay	0.91; acid soluble CaO	(Moist) Saccardo's umber 17^2k(O-Y) Clay (U.S.B.S. class = clay); moderately coherent, sticky, greasy feel
36	75	14	14 15 S 92 05 W 3480 m	Globigerina ooze	91; acid soluble CaO	(Moist) between vinaceous-buff and avellaneous 17^3c(O-Y) Sandy silt (U.S.B.S. class = clay); shells of foraminifera; moderately coherent, granular
37	76	16	15 18 S 97 28 W 3197 m	Globigerina ooze	93; total CO_2	(Moist) (U.S.B.S. class = sand); incoherent, granular; shells of foraminifera

Sample 31. Sand grades consist principally of remains of radiolaria, sponge spicules, and diatoms, together with numerous calcareous benthonic and some arenaceous and pelagic foraminifera, the latter exhibiting slight recrystallization; also present are echinoid spines, chitinous remains, light-colored rod and disk-shaped pellets, green-brown mica (sometimes considerably altered), euhedral green-brown hornblende in colorless pumice, plagioclase feldspar ($Ab_{50}An_{50}$), angular quartz, and olivine (?).

Sample 32. Consists largely of remains of siliceous organisms, especially diatoms, together with light grayish-green clayey material. The sand grades contain numerous light grayish-green rounded and irregularly shaped aggregates of clayey material and siliceous organisms, together with plant material, flakes of brown and greenish mica, sometimes considerably altered, quartz, and feldspar.

Sample 33. Too small for detailed examination. Appears to be similar to sample 32, except that remains of siliceous organisms are relatively less in amount. Contains abundant fresh and partially decomposed plagioclase (labradorite and oligoclase), quartz, green mica, green hornblende, augite, epidote or clinozoisite (2 V about 90°), green garnet or ceylonite, rutile, apatite, magnetite (?), basic volcanic glass, calcite crystals, little clay.

on cruise VII of the Carnegie in the Pacific--Continued

Sampler and container used	Field notes	Nearest previous samples
Ross snapper; 18-oz. bottle and 2 vials	Snapper not closed but brought up good specimen of gray mud and ooze	None
Ross snapper; 18-oz. bottle and 2 vials	Jaws not closed but sample stuck on inside; blackish-green mud	Albatross 4672 (p. 47); 13° 11.6′ S, 78° 18.3′ W. 2845 fathoms. Red clay or blue mud; $CaCO_3$ = zero per cent; nearly 50 per cent fine minerals, 0.01-mm diameter; angular quartz grains, green chlorite, decomposed feldspar, augite, hematite, hornblende (?), some sponge spicules and diatoms; gray flocculent clay
Ross snapper; vial	Snapper failed to close, but thimble full of blue-green mud was found back of tongue	Albatross 4671 (p. 47); 12° 06.9′ S, 12° 28.2′ W. 1490 fathoms. Blue mud; $CaCO_3$ = zero per cent; fine greenish-colored clay, containing many very minute mineral particles, 0.01-mm diameter, and diatoms. Quartz, glauconite, little feldspar, magnetite, and hematite
Ross snapper; 18-oz. bottle and 2 vials	Snapper failed to close, but good amount of grayish clay came up in both jaws	None
Ross snapper; 18-oz. bottle and vial	Snapper failed to close again, but brought up good sample	Albatross 4658 (p. 46); 08° 29.5′ S, 85° 35.6′ W. 2370 fathoms. Red clay; $CaCO_3$ = zero per cent; many genera of arenaceous foraminifera, manganese nodules, sharks' teeth, cetacean ear bones; small grains of manganese and iron oxide; scarce plagioclase, augite, magnetite, hematite; 95 per cent dark gray clay with few undeterminable mineral particles and diatoms
Ross snapper; 18-oz. bottle and 2 vials	Snapper no. 5, made in Callao, Peru, used. White ooze	None
Ross snapper; 2 vials	Snapper closed but most of loose white ooze had washed out	Albatross 4705 (p. 59); 15° 05.3′ S, 99° 19′ W. 2031 fathoms. Globigerina ooze; $CaCO_3$ = 78.62 per cent; 82 species of pelagic and benthonic foraminifera observed; traces of siliceous organisms and the following minerals: basic labradorite, pyrite, decomposed femic mineral, augite?; 21 per cent rich red-brown colored flocculent clay

Sample 34. Coarser material consists of skeletons of radiolaria, diatom frustules, sponge spicules, few pelagic and benthonic foraminifera, brown disk-shaped pellets, plant material and small mineral particles. The considerable amount of clayey material is very low in magnesium and calcium. One entire skeleton of a small crustacean was seen.

Sample 35. Sand grades consist of brown and light-colored (coprolitic?), disk-shaped and ellipsoidal pellets of fine material, together with abundant siliceous remains, common manganese grains, also fine-grained igneous rock, palagonite, angular quartz, and plagioclase.

Sample 36. Although this sample is high in calcium carbonate and in pelagic foraminifera (consequently very light in color), about 50 per cent of shells of foraminifera are broken sand grades. Also contains a few benthonic and arenaceous foraminifera, ostracods, echinoid spines, fish teeth, radiolaria, sponge spicules, manganese grains, and somewhat decomposed plagioclase feldspar. The tests of Globorotalia exhibit recrystallization.

Sample 37. Appears to have been partly washed, as it is very low in fine material. Consists almost entirely of pelagic foraminifera, about three-fourths of which are unbroken.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1929	° ′			
38	77	Feb. 18	14 20 S 103 12 W 4094 m	Red clay	<10; inspection	(Wet) between Brussels-brown and mummy-brown $16^{1/2}$m(O-Y) Sandy clay; shells of foraminifera and angular mineral grains; lumpy, greasy feel
39	78	20	13 02 S 108 03 W 3337 m	Globigerina ooze?	?	No material received
40	79	22	12 36 S 112 14 W 3090 m	Globigerina ooze	78; total CO_2	(Moist) Saccardo's umber 17^2k(O-Y) (U.S.B.S. class = clay)
41	80	24	12 39 S 117 22 W 3515 m	Ferruginous globigerina ooze	90; acid soluble CaO	(Moist) between Saccardo's umber and tawny-olive 17^2j(O-Y) Sandy clay (U.S.B.S. class = clay); shells of foraminifera; slightly coherent, granular, crumbly
42	81	26	13 03 S 121 12 W 2953 m	Globigerina ooze	93; total CO_2	(Dry) pale pinkish-cinnamon 15^2f(Y-O) Silty sand (U.S.B.S. class = sand); shells of foraminifera; slightly coherent, granular
43	82	28	14 52 S 126 07 W 3631 m	Globigerina ooze	89; total CO_2	Sample used up in mechanical analysis. (U.S.B.S. class = clay)
44	83	Mar. 3	17 00 S 129 45 W 3966 m	Globigerina ooze	75; acid soluble CaO and total CO_2	(Dry) avellaneous 17^3b(O-Y); (moist) mummy-brown 17^1m(O-Y); (wet) between Saccardo's umber and snuff-brown 16^2k(YO-OY) Sandy clay (U.S.B.S. class = clay loam); shells of foraminifera; when moist, moderately coherent, very slightly plastic, greasy feel; when dry, moderately coherent, pulverulent, granular

Sample 38. Too small for detailed examination, but appears to be quite similar to sample 30, except that there is a higher percentage of fragments of tests of pelagic foraminifera, and twinned crystals of phillipsite (?) are present.

Sample 39. No sample was received in Washington. According to Seiwell, this sample consisted entirely of broken and intact skeletons of foraminifera together with some "yellowish brown amorphous matter."

Sample 40. Sand grades consist almost entirely of pelagic foraminifera, about 20 per cent of which are broken, together with rare benthonic foraminifera and manganese grains. Silt fractions contain numerous small manganese grains, besides finely divided calcium carbonate and siliceous remains. Bright orange color of colloidal material indicates that it is high in iron.

Sample 41. Similar to no. 40, except that very few of pelagic foraminifera are broken, and small manganese grains are much less common. In both these samples the foraminifera are grayish-tan in color. In addition to pelagic foraminifera, traces of benthonic and arenaceous foraminifera, echinoid spines, ostracods, fish teeth, sponge spicules, and radiolaria are present in sand grades.

Sample 42. Consists almost entirely of pelagic foraminifera, very few of which are broken. Many of these are yellowish-brown in color and some exhibit slight recrystallization. Many very small tests are present. A few siliceous remains, and twins of phillipsite also occur.

on cruise VII of the Carnegie in the Pacific--Continued

Sampler and container used	Field notes	Nearest previous samples
Ross snapper; vial	Snapper not closed, spring too tight. Thimble full of black ooze back of clappers	None
Ross snapper	Snapper closed, but nearly all of white-sand ooze had washed out while hauling in	None
Sigsbee tube; 18-oz. bottle and vial	Snapper not closed, and sample washed out. Sent down Sigsbee tube; good sample black mud	Albatross 4726 (p. 67); 12° 30′S, 111° 42.2′W. 1700 fathoms. Globigerina ooze; $CaCO_3$ = 68 per cent. Pelagic and few benthonic foraminifera, brown clay residue very rich in manganese and limonite grains; few remains of diatoms and sponge spicules; minute mineral particles
Ross snapper; 18-oz. bottle and vial	Snapper, readjusted to hair trigger, closed and brought up good sample, light brown clay and sand	None
Ross snapper; 18-oz. bottle and vial	Snapper closed. One-third full of hard, gray sand and ooze	None
Sigsbee tube; 18-oz. bottle and vial	Good sample; gray globigerina ooze	Albatross 4534 (p. 71); 13° 51′S, 126° 53.5′W. 2185 fathoms. Globigerina ooze. $CaCO_3$ = 72.7 per cent. Pelagic and few bottom-living foraminifera; chocolate-brown flocculent clayey residue, numerous very small phillipsite crystals, few manganese grains, and angular splinters of colorless glass
Ross snapper; 18-oz. bottle and vial	Chocolate mud and ooze. Snapper full	Albatross 4532 (p. 70); 18° 29.4′ S, 130° 50.8′ W. 2319 fathoms. Red clay, $CaCO_3$ = 18 per cent. Pelagic and bottom-living foraminifera and fish teeth; very dark brown flocculent clay residue; great abundance of phillipsite crystals, few manganese grains, and angular splinters of colorless glass

Sample 43. Sand grades consist almost entirely of pelagic foraminifera, about one-fourth of which are broken. The mechanical analysis shows two maxima in the sand and clay grades respectively, and the calcium carbonate content is similarly distributed, indicating two sources of calcareous material. Siliceous organic remains are common, and very small twinned crystals of phillipsite are rare constituents of sand grades.

Sample 44. Coarse sand grades consist largely of remains of pelagic foraminifera, many of which are broken or considerably recrystallized, together with benthonic foraminifera, ostracods, echinoid spines, fish teeth, some siliceous remains, including radiolaria, sponge spicules, and arenaceous foraminifera, few manganese grains, large subhedral grains of fresh plagioclase feldspar, and one of basaltic hornblende, both over 1 mm long. The fine sand grades contain many twinned crystals and aggregates of phillipsite (identified by X-ray powder diagrams) in addition to the above. The clayey material of this sample is quite flocculent; it consists largely of small irregularly shaped grains of calcite, together with some small calcite spherules and rectangular plates, numerous horseshoe-shaped coccoliths, fragments of globigerina shells, large single and some twinned crystals of phillipsite, rounded reddish grains (iron oxide), mottled reddish aggregates (beidellite?), and crescent-shaped shards of brown altered volcanic glass.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1929	° ′			
45	85	Mar. 6	17 12 S 136 37 W 3791 m	Ferruginous globigerina ooze	94; acid soluble CaO	(Dry) pale pinkish-cinnamon 15^2f(Y-O); (moist) between avellaneous and wood-brown 17^3a(O-Y) Clayey sand (U.S.B.S. class = sandy loam); shells of foraminifera; when wet, slightly coherent, granular; when dry, moderately coherent, pulverulent granular
46	86	9	17 36 S 141 55 W 2132 m	Globigerina ooze?	90; inspection	(Dry) fuscous 13^4k(OY-O) Manganese nodules up to 1 cm in diameter partly covered with small unbroken shells of pelagic foraminifera
47	87	11	18 05 S 145 33 W 4315 m	Calcareous red clay	15; total CO_2	(Moist) between bister and sepia 16^2m(Y-O, O-Y) (Dry) clay; coherent, brittle
48	94	Apr. 22	12 47 S 171 35 W 4760 m	Red clay	<10; inspection	(Dry) between light drab and avellaneous $17^{3\text{-}1/2}$b(O-Y) Clay; moderately coherent, pulverulent
49	96	26	6 47 S 172 23 W 5269 m	Red clay	<1; total CO_2	(Moist) between snuff-brown and bister 15^2l(Y-O); (dry) avellaneous 17^3b (O-Y) Clay (U.S.B.S. class = clay); coherent, brittle
50	97	28	3 47 S 172 39 S 5253 m	Red clay	<10; inspection	(Dry) between Saccardo's umber and buffy-brown $17^{2\text{-}1/2}$j(O-Y) Color of coarser fraction (dry) between avellaneous and light drab $17^{3\text{-}1/2}$b(O-Y) Silty clay; moderately coherent, pulverulent, somewhat gritty

Sample 45. Sand grades are similar to sample 44, except that a greater proportion of pelagic shells are unbroken and phillipsite crystals and aggregates are less common. The silt and clay grades apparently contain much more calcium carbonate than sample 44.

Sample 46. The estimate of $CaCO_3$ content for this region is based on the fact that the small tests of pelagic foraminifera found on the manganese nodules are unbroken and fresh in appearance.

Sample 47. Well-formed, ovoid-shaped pellets of fine material, usually containing fragments of foraminiferal shells and sometimes cemented together by a coating of manganese, predominate in the coarser sand grades. Benthonic foraminifera make up a large part of the calcium carbonate content, together with broken shells of pelagic foraminifera, fish teeth, and unidentified calcareous materials; sponge spicules are also present. Manganese grains, volcanic rock fragments, palagonite and phillipsite are common, whereas biotite, feldspar, and hornblende are rare constituents of the sand grades.

Sample 48. The sample is very fine-grained but too small for mechanical analysis. Contains radiolaria, sponge spicules, coccoliths, and unidentified, irregular-shaped calcareous material, as well as basic

on cruise VII of the Carnegie in the Pacific--Continued

Sampler and container used	Field notes	Nearest previous samples
Ross snapper 18-oz. bottle and vial	Good sample; coffee-colored ooze	None
Ross snapper; vial	Snapper closed; hard bottom, few manganese nodules; no trace of ooze	Albatross 37 (p. 95); 18° 08′ S, 141° 49′ W. 2187 fathoms. Globigerina ooze; $CaCO_3$ = 74.2 per cent. Pelagic and benthonic foraminifera, echinoid spines, ostracods, alcyonarian spicules, coccoliths, rhabdoliths, tunicate spicules, siliceous organisms, obsidian, feldspar, augite, magnetite, manganese grains; single and aggregate crystals of phillipsite
Ross snapper; vial	Snapper not closed, but brought up small amount of reddish-brown clay-ooze	Albatross 34 (p. 94); 17° 10′ S, 145° 19′ W. 1679 fathoms. Globigerina ooze. $CaCO_3$ = 84.3 per cent. Pelagic and benthonic foraminifera, echinoid spines, ostracods, otoliths, tunicate spicules, coccoliths, rhabdoliths; few remains of radiolaria, sponge spicules; small angular grains of plagioclase, obsidian, chloritized hornblende, magnetite
Ross snapper; vial		Penguin 331. Murray (1906, p. 132); 14° 49.4′ S, 171° 51.9′ W. 2532 fathoms. Red clay or volcanic mud; $CaCO_3$ = 5 per cent. Small pelagic foraminifera; 50 per cent small pumice particles, 10 per cent radiolaria, sponge spicules, diatoms; 35 per cent brown "amorphous" matter and minute mineral particles
Sigsbee tube; 12-oz. bottle	Sigsbee tube; weight detached; chocolate mud and ooze	Egeria 47. Murray (1906, p. 131); 07° 52′ S, 171° 01.5′ W. 2766 fathoms. Red clay; $CaCO_3$ not determined. Few fragments of pelagic foraminifera and fish teeth, pumice fragments and manganese grains, sponge spicules, radiolaria, diatoms; dark brown or chocolate color. "Fine washings," 77 per cent
Sigsbee tube; 12-oz. bottle	Small sample chocolate ooze	Tuscarora, Dec. 25, 1875. Murray (1906, p. 127); 03° 21′ S, 171° 23′ W. 2835 fathoms. Globigerina ooze (with many radiolaria); $CaCO_3$ = 42.1 per cent. Mostly fragmentary pelagic foraminifera; numerous coccoliths, few tunicate spicules, much crystalline and "amorphous" calcareous matter, 25 per cent remains of siliceous organisms, a few manganese grains, palagonitic and glassy volcanic particles

volcanic glass, pumice, palagonite, small manganese grains, plagioclase feldspar, augite, euhedral hypersthene (?), magnetite (?), birefringent clay minerals (?) and unidentified, small mineral particles.

Sample 49. One distinction of the sand grades of this sample is the presence of an extraordinary number of fish teeth and chitinous fragments. Sponge spicules, radiolaria, and both benthonic and pelagic foraminifera are other common organic constituents. Another feature is the presence of many compact, irregularly rounded particles probably of altered pumice, containing palagonite, augite, and unaltered plagioclase feldspar, together with much isotropic material. In addition, brownish, ovoid aggregates probably formed during mechanical analysis are present, as well as manganese grains.

Sample 50. Too small for mechanical analysis. Contains arenaceous foraminifera, fish teeth, pelagic foraminifera, radiolaria, sponge spicules, diatoms, unidentified calcareous fragments, biotite, manganese grains and flakes, basic volcanic glass (some grains of which are slightly birefringent), palagonite, a euhedral augite crystal, penninite (?), brown-colored clay mineral showing moderate birefringence, negative elongation, indices of refraction about 1.565, large 2 E.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
51	108	1929 May 27	18° 26′ N 144 01 E 3573 m	Volcanic mud	16; total CO_2	(Moist) between light brownish-olive and brownish-olive 19^2l(Y-O-Y) (U.S.B.S. class = clay loam)
52	109	29	23 22 N 144 08 E 5252 m	Red clay	<5; inspection	(Dry) avellaneous 17^3b(O-Y) Clay; moderately coherent, crumbly
53	110	31	26 20 N 144 24 E 3036 m	Volcanic globigerina mud	48; total CO_2	(Dry) pale pinkish-cinnamon 15^2f(Y-O) Sandy clay (U.S.B.S. class = clay); foraminifera; volcanic glass; slightly coherent, pulverulent, gritty
54	111	June 3	31 00 N 144 16 E 6008 m	Brown volcanic mud	5; total CO_2	(Moist) light drab 17^3b(O-Y) Silty clay (U.S.B.S. class = silty clay loam); moderately coherent, pulverulent
55	112	5	33 51 N 141 15 E 3931 m	Gray volcanic mud	<10; inspection	(Dry) between hair-brown and deep grayish-olive 19^4i(Y-O-Y); (moist) silt; angular grains; slightly coherent, crumbly, gritty feel
56	113	25	34 44 N 141 04 E 2911 m	Gray siliceous volcanic mud	4; acid soluble CaO	(Moist) deep grayish-olive 21^4i(O-YY) Silty clay (U.S.B.S. class = clay); angular grains; moderately coherent, slightly sticky, gritty
57	115	29	37 40 N 145 26 E 5396 m	Volcanic radiolarian ooze	1; acid soluble CaO	(Dry) between buffy-brown and drab $17^{3-1/2}$h(O-Y) Silty clay (U.S.B.S. class = clay); coherent, crumbly

Sample 51. Organic remains include abundant pelagic foraminifera, common arenaceous and benthonic foraminifera, and radiolaria. Predominant constituents of sand grades are angular fragments of fresh pumice (index of refraction about 1.50), fresh, dark-colored vesicular basic glass (index of refraction about 1.56), quartz, plagioclase feldspar, and hornblende.

Sample 52. Very small fine-grained sample. Organic skeletal material is scarce, chiefly radiolaria and sponge spicules. Basic volcanic glass (index of refraction somewhat less than 1.545), vesicular pumice, plagioclase feldspar (labradorite and some andesine), green augite, quartz, magnetite, manganese grains and flakes, limonite, clay mineral similar to that described for sample 50, and much fine unidentified material make up bulk of the sample.

Sample 53. Similar to sample 51, except that pelagic foraminifera are much more abundant and pumice fragments are replaced in the sand grades largely by vesicular basic volcanic glass. Quartz is abundant.

Sample 54. The organic remains consist of radiolaria shells (sometimes coated with manganese), fish teeth, occasional diatoms, sponge spicules, fragments of pelagic foraminifera, and arenaceous foraminifera, the latter consisting largely of angular grains of feldspar, sometimes coated with iron oxide, and volcanic glass. About 60 per cent of the sand grades is made up of pumice (index of refraction about 1.50), other inorganic materials are biotite, manganese grains, some basic volcanic glass, and plagio-

on cruise VII of the Carnegie in the Pacific--Continued

Sampler and container used	Field notes	Nearest previous samples
Sigsbee tube; vial	Bottom sample brown mud in Sigsbee tube no. 2 with detachable weight	Nero 1036. Flint (1905, p. 24); 18° 08.5′ N, 144° 04.7′ E. 2155 fathoms. Volcanic mud; $CaCO_3$ not determined. Light brown, finely granular, nonadhesive mud, containing few foraminifera and relatively little "amorphous" matter. Remainder consists of fine angular mineral fragments
Sigsbee tube; vial	Hard bottom; small fragments of sample; two dents in Sigsbee tube no. 2; no water in tube	Nero 1084. Flint (1905, p. 24); 22° 45.5′ N, 143° 40.7′ W. 2313 fathoms. Volcanic mud; $CaCO_3$ not determined. Light brownish-gray, granular. Occasional foraminifera, many radiolaria and much volcanic glass, some grains brown and porous, others filamentous, remainder sharp, angular, transparent fragments
Sigsbee tube; 12-oz. bottle	Used Sigsbee tube no. 2, detachable weight. Good sample of cream-colored clay-ooze and volcanic sand	Nero 1126. Flint (1905, p. 25); 26° 12.7′ N, 143° 08′ E. 972 fathoms. Volcanic mud; $CaCO_3$ not determined. Mostly volcanic sand with a few pelagic and benthonic foraminifera
Sigsbee tube; 12-oz. bottle	Good conditions	None
Sigsbee tube; vial	Tube had small fragment clay and black mud. Hard bottom	Nero 1207. Flint (1905, p. 25); 33° 22′ N, 140° 35.7′ E. 635 fathoms. Blue mud; $CaCO_3$ not determined. Few small foraminifera and radiolaria; coarse mineral fragments, many of them black; many fragments coated with palagonite
Sigsbee-Ross snapper; 12-oz. bottle	Good sample	Challenger 237 (p. 112); 34° 37′ N; 140° 32′ E. 1875 fathoms. Blue mud; $CaCO_3$ = 4.45 per cent; 1.5 per cent pelagic, 1 per cent benthonic foraminifera, 2 per cent otoliths and vertebrae of fish, cephalopod beaks, pteropod and heteropod fragments, echinoid spines. Siliceous organisms 5 per cent, remainder clay and a large amount of volcanic material including orthoclase and plagioclase, augite, hornblende, magnetite, black vesicular glass, pumice, biotite, manganese
Sigsbee-Ross snapper; 12-oz. bottle		None

clase feldspar (labradorite).

Sample 55. Very small, fine-grained sample. The small amount of siliceous organic material is made up of the remains of radiolaria, diatoms, and sponge spicules. Basic volcanic glass, pumice, and fine-grained material make up approximately one-half of sample. Other constituents are abundant plagioclase, some quartz, green hornblende, biotite, magnetite, augite, chlorite, colorless garnet, and palagonite.

Sample 56. Radiolaria make up about 60 per cent by volume of the sand grades of this sample; most of the remainder is of basic volcanic glass (index of refraction about 1.56), containing many microlites of feldspar and augite--some of the fragments of glass are slightly altered around the borders. Other constituents of sand grades are arenaceous foraminifera, few pelagic foraminifera, sponge spicules, some diatoms; colorless and light green pumice, quartz, biotite, euhedral hypersthene, plagioclase feldspar (labradorite), palagonite (?), hornblende, monoclinic feldspar, and augite. Magnetite is not common. The silt and clay fractions consist largely of plagioclase, monoclinic feldspar, volcanic glass, and the other minerals noted above, together with some diatoms and fragments of radiolaria. A clay mineral of high index of refraction (about 1.56) and appreciable birefringence is present in the clay grade.

Sample 57. Similar to sample 56, except for brown rather than gray color, greater abundance of siliceous organisms, and smaller amounts of basic volcanic glass and heavy minerals. Contains one large rounded

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1929	° ′			
58	116	July 1	38 41 N 147 41 E 5545 m	Volcanic diatom or radiolarian ooze	1; acid soluble CaO	(Dry) olive-brown 17^3k(O-Y); (moist) silty clay (U.S.B.S. = clay); frustules of diatoms; moderately coherent, crumbly
59	117	3	40 20 N 150 58 E 5296 m	Diatom ooze	0.46; acid soluble CaO	(Moist) mummy-brown 17^1m(O-Y) Silty clay (U.S.B.S. class = clay); frustules of diatoms; moderately coherent, crumbly
60	119	7	45 24 N 159 36 E 5198 m	Diatom ooze	0.93; acid soluble CaO	(Dry) between vinaceous-buff and avellaneous 17^3c(O-Y) Clayey silt (U.S.B.S. class = clay); frustules of diatoms; moderately coherent, crumbly
61	127	23	44 16 N 137 37 W 4026 m	Gray clayey mud	1; acid soluble CaO	(Dry) near light grayish-olive $21^{4-1/2}$c(OYY); (moist) brownish-olive 19^2m(YO-Y) Clay (U.S.B.S. class = clay); coherent; when moist, somewhat plastic; when dry, brittle
62	128	25	40 37 N 132 23 W 3806 m	Red clay	7; total CO_2	(Dry) between tilleul-buff and vinaceous-buff 17^3e(O-Y) Clay (U.S.B.S. class = clay); few shells of foraminifera; coherent; when moist, slightly plastic, moderately sticky; when dry, brittle
63	130	Sep. 4	37 05 N 123 43 W 3188 m	Green mud	<5; inspection	(Dry) between light grayish-olive and grayish-olive 21^4a(O-YY) Clay; coherent, brittle
64	131	6	33 49 N 126 20 W 4418 m	Red clay	0.57; acid soluble CaO	(Dry) between light drab and dark gray 17^4c(O-Y) Clay (U.S.B.S. class = clay); coherent, brittle

piece of fresh pumice over 1 cm in diameter and 2 manganese-palagonite nodules of about the same size. One of these, when sectioned (see plate XIII) shows the spherulitic alteration of colorless isotropic volcanic glass in the center, to reddish-orange palagonite, containing fresh phenocrysts of monoclinic feldspar and hornblende, near the surface. The palagonite spherulites are often surrounded by manganese; some of them are entirely replaced by manganese, which is distributed in more or less laminar fashion. Nearer the surface there are only isolated fragments of palagonite spherulites in the thick manganese coating.

Sample 58. Radiolaria are very abundant in this sample, but the principal component is perhaps diatoms at least in the finer grades. Other organic components are sponge spicules and arenaceous foraminifera. Inorganic components of sand grades include: rounded grains of fresh pumice, 3 mm in longest diameter, in which there are porphyritic clusters of magnetite, hypersthene, green hornblende and plagioclase feldspar (labradorite, $Ab_{45}An_{55}$); a few semiangular fine-grained volcanic rock particles about 1 mm in diameter which contain small crystals of plagioclase feldspar; together with plagioclase, quartz, basic volcanic glass, and monoclinic feldspar. Subhedral hornblende is the chief heavy mineral, followed by euhedral hypersthene, magnetite crystals, biotite, and colorless augite. Some of the plagioclase particles are zoned.

Sample 59. Both diatoms and radiolaria make up a very large proportion of this sample, but diatoms predominate, especially in the finer grades. Other organic remains are arenaceous foraminifera, sponge fragments, and pelagic foraminifera. Semiangular grains of quartzite, limestone, and a fine-grained volcanic rock are apparently ice-borne. Besides these, there are small amounts of basic volcanic glass (index of refraction greater than 1.56) and pumice (index of refraction 1.515). These are exactly similar in appearance to the glass and pumice from samples 56 on, the glass being packed as usual with microlites of feldspar. Some of the grains of the pumice are rounded. Very fresh plagioclase feldspar (labradorite), quartz, monoclinic feldspar, biotite, hypersthene in euhedral single and twinned crystals, hornblende, magnetite and pyroxene (?) are also present in the sand grades.

on cruise VII of the Carnegie in the Pacific--Continued

Sampler and container used	Field notes	Nearest previous samples
Sigsbee-Ross snapper; 12-oz. bottle	Snapper successful; weights detached. Good sample, reddish-brown and green mud	None
Sigsbee-Ross snapper; 12-oz. bottle	Good sample brown-gray mud	None
Sigsbee-Ross snapper; 12-oz. bottle	Good reddish-brown ooze in snapper	None
Sigsbee-Ross snapper; 2 12-oz. bottles		None
Sigsbee-Ross snapper; 2 12-oz. bottles		None
Sigsbee-Ross snapper; vial	Snapper did not close. Small amount of dark green mud in jaws	None
Sigsbee-Ross snapper; 12-oz. bottle	Snapper full of light brown clay	None

Sample 60. Diatoms greatly predominate in this sample. A few radiolaria and arenaceous foraminifera are present. Subrounded to subangular grains of volcanic rock, quartzite and unidentified fine-grained rocks, together with pumice, quartz, and volcanic minerals, as above, are present in the sand grades. Samples 56 to 60 are strikingly similar in chemical composition, but show a progressive increase in number of siliceous organisms, especially diatoms, and a decrease in volcanic components, particularly heavy minerals, toward the east. Ice-borne fragments also increase in number toward the east.

Sample 61. Radiolaria predominate in the sand grades. Arenaceous foraminifera are common, and sponge spicules and fish teeth are found. A few diatoms occur in the finer sand and silt, as well as some unidentified calcareous material. The inorganic constituents of the sand grades include pumice (index of refraction about 1.50), plagioclase feldspar (oligoclase $Ab_{75}An_{25}$), manganese flakes, and basic volcanic glass, the latter sometimes coated with iron oxide. The color of this sample indicates terrigenous influence even though the distance from shore is great and the nitrogen content is not larger than that of other north Pacific clays.

Sample 62. Radiolaria predominate in the sand grades. Other components of sand size are fragments of pelagic foraminifera, abundant benthonic foraminifera (ratio of pelagic to benthonic foraminifera about 7 to 1), fish teeth, echinoid spines, arenaceous foraminifera, manganese grains, biotite, feldspar, and hornblende.

Sample 63. Very small, fine-grained sample. Contains abundant radiolaria, also diatoms and sponge spicules, green hornblende, green garnet, titanite or octahedrite, quartz, brown mica (2E about 15 degrees), monoclinic feldspar, basic volcanic glass, brownish glauconite (?) magnetite, and unidentified fine-grained material.

Sample 64. Radiolarian skeletons are most abundant organic remains; arenaceous foraminifera are common; sponge spicules, black volcanic rock fragments, manganese grains, biotite, pumice and basic volcanic glass, the latter sometimes slightly birefringent, palagonite, plagioclase feldspar, and hornblende are observed in the sand grades.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1929	° ′			
65	132	Sep. 8	31 38 N 128 48 W 4251 m	Red clay	0.46; acid soluble CaO	(Dry) between vinaceous-buff and avellaneous 17^3c(O-Y); (moist) olive-brown 17^3k(O-Y) Clay (U.S.B.S. class = clay); when moist, moderately coherent, moderately plastic, slightly sticky; when dry, coherent, brittle
66	133	10	29 21 N 132 20 W 4426 m	Red clay	0.68; acid soluble CaO	(Dry) between light drab and drab 17^4a(O-Y); (moist) between raw umber and mummy-brown $17^{1/2}$m(O-Y) Clay (U.S.B.S. class = clay); coherent; when moist, plastic, when dry, brittle
67	134	12	27 45 N 135 22 W 4528 m	Red clay	<1; inspection	(Dry) sepia 17^2m(O-Y) (Slightly moist) clay; coherent, plastic (?)
68	135	14	26 39 N 139 07 W 4695 m	Red clay	<1; inspection	(Dry) avellaneous 17^3b(O-Y) Clay; coherent, brittle, smooth feel
69	136	16	26 13 N 142 02 W 4713 m	Red clay	0.80; acid soluble CaO	(Dry) between vinaceous-buff and avellaneous 17^3c(O-Y); (moist) between snuff-brown and Saccardo's umber 16^2k(YO-OY) Clay (U.S.B.S. class = clay); coherent; when moist, moderately plastic, slightly sticky; when dry, coherent, brittle
70	137	18	24 02 N 145 33 W 5208 m	Red clay	1; acid soluble CaO	(Dry) vinaceous-buff 17^3d(O-Y); (moist) between mummy-brown and Saccardo's umber $17^{1-1/2}$l(O-Y) Clay (U.S.B.S. class = clay); when moist, moderately coherent, moderately plastic, moderately sticky; when dry, coherent, brittle
71	138	20	22 53 N 151 15 W 5382 m	Red clay	<1; inspection	(Dry) between tilleul-buff and vinaceous-buff 17^3e(O-Y) Clay; coherent, brittle

Sample 65. Sand grades are very small in amount, as in most north Pacific red clays. They consist largely of radiolaria, arenaceous foraminifera, and sponge spicules, together with some flakes and grains of iron manganese oxide, somewhat altered fragments of plagioclase feldspar (oligoclase), and fresh microcline.

Sample 66. Radiolaria make up about 70 per cent of the sand grades. Fragments of arenaceous foraminifera, sponge spicules, diatom frustules, and fragments of fish teeth are other organic remains. Manganese grains and limonitic and manganese flakes, plagioclase feldspar (andesine), orthoclase, colorless pumice, and one magnetic spherule, are other identified components of sand size.

Sample 67. Small, fine-grained sample. Remains of organisms are rare--a few diatom fragments. Contains much birefringent material (clay minerals), also augite grains, hornblende needles and cleavage fragments, green garnet (?), oligoclase feldspar (or quartz?), basic glass, and manganese grains.

Sample 68. Very small, fine-grained sample. Remains of organisms are rare. Much birefringent ma-

on cruise VII of the Carnegie in the Pacific--Continued

Sampler and container used	Field notes	Nearest previous samples
Carnegie-Ross pelican-snapper; 12-oz. bottle and glass jar	New triple-size pelican snapper sent down for first time. Struck something at 542 m, closed and weights detached. Hauled up, new weights put on and sent down again. Came up full, about 1 and 1/2 qts. dark brown clay, stiffer than usual	None
Carnegie-Ross pelican-snapper; 2 glass jars	Snapper not quite full of dark brown clay; fairly stiff	None
Carnegie-Ross pelican-snapper; vial	Snapper closed, but came up empty. Enough dark brown mud on outside of jaws for examination. Mud may have been too stiff to allow jaws to grip when the snapper was pulled off bottom	None
Carnegie-Ross pelican-snapper; vial	Snapper apparently closed going down, and struck closed. Small sample of dark brown mud on outside	None
Carnegie-Ross pelican-snapper; 3 glass jars	Snapper was full of dark brown mud, as for all previous samples since San Francisco. Sample weighed 4 lbs., 4 oz.	None
Carnegie-Ross pelican-snapper; 2 glass jars	Snapper full of dark brown mud as before	None
Carnegie-Ross pelican-snapper; vial	Snapper did not close owing to new spring being too stiff. Small sample dark brown mud inside jaws	None

terial, probably mostly clay minerals, is present. Feldspar, hornblende, and a few manganese grains also were identified.

Sample 69. Remains of organisms are fairly common, and include radiolaria, sponge spicules, arenaceous foraminifera, and fish teeth. In addition, the sand grades contain cleavage fragments of brown hornblende (-2V=80), plagioclase feldspar (andesine, $Ab_{60}An_{40}$), and round manganese grains.

Sample 70. Sand grades are very small in amount. Remains of organisms are principally diatoms, together with radiolaria, sponge spicules, arenaceous foraminifera, and fish teeth. Round manganese-iron grains of sand size are also present.

Sample 71. Very small, fine-grained sample. Contains very few remains of organisms, chiefly radiolaria. Also contains augite, orthoclase, hornblende, plagioclase (andesine), basic volcanic glass, and manganese.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1929	° ′			
72	142	Oct. 7	32 42 N 160 44 W 5787 m	Red clay	0.57; acid soluble CaO	(Moist) raw umber 17m(O-Y) (Slightly moist) clay (U.S.B.S. class = clay); coherent, plastic
73	145	13	33 27 N 145 30 W 5584 m	Red clay	0.72; acid soluble CaO	(Dry) wood-brown 17^3(O-Y) Clay (U.S.B.S. class = clay); coherent, brittle
74	146	15	31 50 N 141 50 W 4756 m	Red clay	1; total CO_2	(Moist) mummy-brown 17^1m(O-Y) Clay (U.S.B.S. class = clay); moderately coherent, brittle, when dry
75	147	17	27 27 N 138 14 W 4840 m	Red clay (?)	<1; inspection	(Dry) between fuscous and fuscous-black 13^4l(OY-O) Sandy silt; angular grains of manganese; slightly coherent, gritty
76	148	19	24 57 N 137 44 W 4835 m	Red clay	<1; inspection	(Moist) olive-brown 17^3k(O-Y) Clay; coherent, plastic
77	149	21	21 18 N 138 36 W 5320 m	Red clay	0.72; acid soluble CaO	(Dry) drab 17^4(O-Y) Clay (U.S.B.S. class = clay); coherent, brittle
78	150	23	16 15 N 137 06 W 4553 m	Red clay (?)	<1; inspection	(Dry) between dark Quaker-drab and sooty-black 1^5l(red) Two cinders of volcanic rock coated with manganese. Average diameter approximately 1 cm
79	151	25	12 40 N 137 32 W 4918 m	Radiolarian ooze	1; acid soluble CaO	(Moist) near wood-brown; $17^{2\text{-}1/2}$(O-Y) Clay (U.S.B.S. class = clay); moderately coherent, slightly plastic, sticky
80	153	29	7 45 N 141 24 W 5003 m	Radiolarian ooze	Trace; acid soluble CaO	(Moist) Saccardo's umber 17^2k(O-Y) Clay (U.S.B.S. class = clay); few shells of foraminifera; moderately coherent, slightly plastic

Sample 72. Contains large amounts of siliceous organisms including radiolaria, sponge spicules, and arenaceous foraminifera; a few pelagic foraminifera and fish teeth are also present. Inorganic constituents of sand grades include pumice (in grains ranging up to 3 mm in diameter), manganese grains, feldspar, and hornblende.

Sample 73. Sand grades are small in amount. Organic remains include radiolaria, sponge spicules, arenaceous foraminifera and a few fish teeth. Manganese grains are common; other constituents of sand size are fresh and partially altered feldspar, hornblende, brown mica, and augite.

Sample 74. The small amounts of sand grades contain radiolaria, sponge spicules, fish teeth, arenaceous and pelagic foraminifera, also abundant manganese grains, pumice (often stained red brown), feldspar, and fractured euhedral grains of magnetite.

Sample 75. Consists of opaque angular grains of volcanic ash (less than 2 mm in longest diameter), coated with manganese, together with angular manganese grains, reddish-yellow, irregularly shaped, birefringent aggregates (beidellite), rare plagioclase feldspar, and considerable iron oxide.

Sample 76. Small, fine-grained sample, contains much birefringent material, also basic volcanic glass, small irregular grains of calcium carbonate of unknown origin, plagioclase feldspar, augite, needles of

Sampler and container used	Field notes	Nearest previous samples
Sigsbee-Ross snapper; glass jar	Full of light brown clay	None
Sigsbee-Ross snapper; 12-oz. bottle	Snapper did not close, but one jaw was full of light brown mud	None
Sigsbee-Ross snapper; 12-oz. bottle	Most of sample had washed out. Same color as before--light brown mud	None
Carnegie-Ross pelican-snapper; vial	Pelican snapper closed but brought up very small amount of fragments of manganese grains and black volcanic ash	None
Carnegie-Ross pelican-snapper; vial	Snapper not closed, but small sample of light brown clay on jaws	None
Carnegie-Ross pelican-snapper; 3 glass jars	Snapper closed; good sample; light brown mud	None
Carnegie-Ross pelican-snapper; vial	Snapper closed but only one small cinder of black lava inside	Albatross 11 (p. 83); 14° 38′ N, 136° 44′ W. 2646 fathoms. Red clay; $CaCO_3$ = 1 per cent; fish teeth; few siliceous organisms and small angular mineral grains; feldspar, glass, augite, magnetite, manganese grains; phillipsite. Dark mottled brown in color. Largely "amorphous" clayey matter
Carnegie-Ross pelican-snapper; 3 glass jars	Snapper came up full of light brown mud. Sample streaked with white clay and contained one manganese nodule, size of lemon	Albatross 12 (p. 83); 12° 07′ N, 137° 18′ W. 2883 fathoms. Radiolarian ooze; $CaCO_3$ = 1 per cent; greater than 30 per cent siliceous organisms, 2 per cent glass, feldspar, hornblende; the remainder "amorphous" clayey matter. Light brown in color
Carnegie-Ross pelican-snapper; 3 glass jars	Good sample. Snapper full of light brown, black-gray, white mixture mud-ooze	None

hornblende, and manganese grains.

Sample 77. Sand grades contain radiolaria, sponge spicules, and fish teeth in addition to abundant manganese grains, pumice, plagioclase feldspar (andesine), and pyroxene.

Sample 78 consists of two volcanic cinders about 1 cm in diameter coated with manganese and cemented together with the same material.

Sample 79. According to Piggott, the manganese nodule occurring in this sample contains alternating rings of clay and manganese dioxide, but no nucleus of other material. It was not received in La Jolla. Sand grades, large in amount when compared with samples 61 to 77, consist largely of radiolaria, together with diatoms, sponge spicules, arenaceous foraminifera, white (coprolitic?) pellets, manganese grains (containing nuclei of colorless volcanic glass), pumice, and green volcanic rock fragments.

Sample 80. Sand grades contain, besides radiolaria, numerous large manganese grains, white rod-shaped coprolitic pellets and tubes, gray ellipsoidal pellets, fish teeth, sponge spicules, arenaceous foraminifera, very few pelagic foraminifera, olivine, euhedral plagioclase (over 1 mm in diameter), quartz, hornblende, augite, and volcanic scoria.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1929	° ′			
81	156	Nov. 4	3 01 N 149 46 W 4953 m	Siliceous globigerina ooze	40; acid soluble CaO	(Moist) partly pinkish-buff 17^2d(O-Y); partly Saccardo's umber 17^2k(O-Y). Sample has two colors but both parts have same physical characters Silty clay (U.S.B.S. class = clay); small shells of foraminifera and radiolarian tests; moderately coherent, sticky, greasy feel
82	157	6	1 48 S 152 22 W 4693 m	Siliceous globigerina ooze	85; acid soluble CaO	(Dry) pale pinkish-cinnamon 15^2f(Y-O); (moist) vinaceous-buff 17^3d(O-Y) Sandy clay (U.S.B.S. class = clay); shells of foraminifera and radiolarian tests; when moist, slightly coherent, crumbly; when dry, moderately coherent, pulverulent, gritty
83	158	8	6 33 S 154 58 W 4065 m	Globigerina ooze	90; inspection	(Wet) between tilleul-buff and white 17^3g(O-Y) Sand; all foraminifera shells and manganese grains; incoherent
84	159	11	9 24 S 159 01 W 5545 m	Red clay	<5; inspection	(Dry) mummy-brown 17^1m(O-Y) Clay; coherent, brittle
85	160	13	10 54 S 161 53 W 2614 m	Globigerina ooze	94; acid soluble CaO	(Dry) pale pinkish-cinnamon 15^2f(Y-O); (moist) between vinaceous-buff and avellaneous 17^3c(O-Y) Clayey sand (U.S.B.S. = clay); shells of foraminifera; slightly coherent; when moist, crumbly, granular; when dry, crumbly
86	161	15	12 04 S 164 57 W 4484 m	?	?	
87	162	17	13 36 S 168 23 W 5124 m	?	?	

Sample 81. Sand grades consist almost entirely of remains of foraminifera, radiolaria, and other calcareous and siliceous organisms, including sponge spicules, arenaceous foraminifera, diatoms, echinoid spines, and fish teeth, but a few manganese grains are also present. Pronounced recrystallization is evident in tests of Globorotalia tumida. Eighty-five per cent of the tests of pelagic foraminifera are broken.

Sample 82. Many species of calcareous and arenaceous benthonic foraminifera; also radiolaria, diatoms, sponge spicules, fish teeth, echinoid spines, ostracods, are present in sand grades in addition to mostly broken tests of pelagic foraminifera, the latter exhibiting some recrystallization, and coccoliths. Inorganic constituents of sand size include manganese grains, fine-grained igneous rock fragments, plagio-

Sampler and container used	Field notes	Nearest previous samples
Carnegie-Ross pelican-snapper; 2 glass jars	Good bottom sample. Used Pelican no. 1. [Evidence of stratification of red clay and globigerina ooze. Contains one cinder (?)]	Challenger 270 (p. 120); 02° 34′ N, 149° 09′ W. 2925 fathoms. Globigerina ooze; $CaCO_3$ = 71.47 per cent; 65 per cent pelagic foraminifera; 1 per cent benthonic foraminifera; 5 per cent fish teeth, echinoid spines, abundant coccoliths; 5 per cent radiolaria, diatoms; 1 per cent angular volcanic glass, feldspar, manganese grains; 23 per cent fine "amorphous" matter and siliceous organisms. Lower part of core nearly pure globigerina ooze, upper part half and half siliceous and calcareous organisms
Carnegie-Ross pelican-snapper; 2 glass jars	Pelican no. 1 full of white globigerina ooze	Challenger 271 (p. 120); 00° 33′ S, 157° 34′ W. 2425 fathoms. Globigerina ooze; $CaCO_3$ = 81.27 per cent. Pelagic foraminifera 70 per cent; 3 per cent benthonic foraminifera; 8 per cent fish teeth, lamellibranchs, ostracods, echinoderm fragments, bryozoa, coccoliths; 10 per cent radiolaria, sponge spicules, arenaceous foraminifera; 9 per cent clay and siliceous remains; 1 egg-sized pumice fragment collected
Nansen water bottle; vial	Small amount of globigerina ooze in Nansen bottle Y	Challenger 274 (p. 122); 07° 25′ S, 152° 15′ W. 2750 fathoms. Radiolarian ooze; $CaCO_3$ = 3.89 per cent; red-brown colored, unctuous, slightly coherent, earthy; largely siliceous organisms, some angular small mineral grains, feldspar, augite, magnetite, magnetic spherules, manganese, phillipsite, pumice. Numerous manganese nodules, earbones of cetaceans, shark teeth, pumice, palagonitic and zeolitic materials obtained in trawl
Carnegie-Ross pelican-snapper; vial	Snapper not closed. Small amount red clay inside jaws	None
Carnegie-Ross pelican-snapper; 2 glass jars	Snapper half full of white globigerina ooze	None
Carnegie-Ross pelican-snapper; ?	Snapper came up with jaws held partly open by small black nodule; small amount ooze and clay inside jaws	
Carnegie-Ross pelican-snapper	Pelican no. 1 came up closed, but only smear of bottom mud. Must have closed going down	

clase feldspar, angular quartz grains (possibly owing to contamination), basic volcanic glass, and magnetite.
Sample 83. Probably partially washed on being brought up. Consists of pelagic foraminifera and small amount of manganese grains.
Sample 84. Too small for detailed microscopic examination.
Sample 85. Consists almost entirely of unbroken tests of pelagic foraminifera, together with traces of calcareous and arenaceous benthonic foraminifera, echinoid spines, radiolaria, and sponge spicules.
Sample 86. Lost in destruction of Carnegie at Apia.
Sample 87. Lost in destruction of Carnegie at Apia.

Table 3. Synoptic table of bottom samples collected

Sample	Station	Date	Position and depth in meters	Type of sample	Estimated $CaCO_3$ content in per cent; basis of estimate	Color and physical characters
		1930	° ′			
88	Callao harbor Peru	Between Jan. 13 and Feb. 6	12 00 S 77 00 W ?	Gray mud	4; acid soluble CaO	None
89	Hanga Rua, Easter Island		27 00 S 109 00 W ?	Volcanic calcareous sand	70; acid soluble CaO	None

Sample 89. Contains over 5 per cent $MgCO_3$; 70 per cent of sample consists of calcareous organisms: madreporarian corals 15 per cent; coralline algae 12 per cent, Halimeda 3 per cent, foraminifera 10 per cent, gastropods 10 per cent, pelecypods 10 per cent, echinoid spines 8 per cent, tunicate spicules 1 per

on cruise VII of the Carnegie in the Pacific--Concluded

Sampler and container used	Field notes	Nearest previous samples
Mann diatom dredge; 7 18-oz. bottles	Field notes destroyed	None
Mann diatom dredge; 18-oz. bottle (alcoholic)	Field notes destroyed except label	None

cent, trace alcyonarian spicules and worm tubes; inorganic remains make up 30 per cent: fragments of volcanic rock and volcanic minerals.

Table 4. Sonic depths--number and geographic position of sounding

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1928	° ′	° ′		
		Atlantic Ocean			
0	May 13	37 42.1	63 36.0	..	5092 ± 200[a]
1	13	37 43.0	63 21.8	..	4882 ± 200[a]
2	15	36 58.7	56 49.3	2	5321
3	16	37 53.8	52 37.7	2	5282
4	17	38 10.0	50 03.1	2	5302
5	17	38 12.1	49 38.6	2	5263
6	17	38 09.5	48 57.7	2	5224
7	17	38 07.1	48 14.9	2	5224
8	19	40 36.6	41 50.8	2	4868
9	20	41 51.8	38 57.8	3	4307
10	21	43 59.9	36 09.6	3	3743[b]
11	21	43 59.9	36 09.6	3	3733[c]
12	22	45 18.0	33 34.1	4	3581
13	22	45 40.7	32 54.4	4	2530
14	23	44 45.0	33 05.2	4	2439
15	25	43 17.1	31 33.0	5	2006[d]
16	25	43 17.1	31 33.0	5	2449
17	25	43 13.2	31 13.6	5	2232
18	26	44 03.5	28 15.5	5	1748 ± 20
19	27	45 49.1	25 31.6	5	2318
20	27	46 06.5	25 05.1	5	2271
21	28	48 17.1	20 46.9	6	3300
22	29	48 50.2	19 16.1	6	4400
23	29	48 50.2	18 49.6	6	3024
24	30	49 50.3	15 05.0	6	4442
25	30	49 59.8	14 26.6	6	3974
26	30	50 03.6	14 10.1	6	3886
27	31	50 20.6	13 31.2	6	2613
28	31	50 21.1	13.31.1	6	2604
29	31	50 16.9	13 24.3	6	2574
30	31	50 04.3	13 17.0	6	2653
31	June 1	50 06.7	13 10.7	6	2673
32	1	50 07.8	13 06.9	6	2575
33	1	50 05.5	13 03.4	6	2622 ± 30
34	1	50 03.3	12 58.9	6	2553
35	1	49 55.8	12 47.1	6	2506
36	1	49 47.5	12 39.3	6	2441 ± 25
37	2	49 26.7	12 10.8	6	1238 ± 25
38	2	49 34.5	12 09.6	6	1357
39	2	49 40.5	12 16.1	6	1508
40	3	50 10.8	12 30.2	6	2445
41	4	50 21.7	12 25.9	6	2420 ± 30
42	4	50 13.2	11 54.9	6	2066
43	4	49 56.5	11 25.7	6	678 ± 20
44	4	49 45.0	11 24.5	6	614 ± 10
45	5	50 07.0	11 17.4	6	745 ± 10
46	5	50 01.4	11 13.3	6	631 ± 15
47	5	50 00.4	11 13.3	6	850 ± 10
48	5	49 54.0	11 07.6	6	477 ± 10
49	5	49 53.7	10 56.9	6	362 ± 10
50	5	49 57.8	10 48.3	6	193
51	5	49 58.1	10 47.2	6	161
52	5	50 02.6	10 34.3	6	149
53	6	50 18.2	10 04.1	6	122
54	6	50 10.9	10 01.8	6	128
55	6	50 20.7	9 28.1	6	118
56	7	50 17.3	8 04.1	6	110[e]
57	7	50 17.3	8 04.1	6	105[e]
			E		
58	July 10	58 36.1	1 58.5	7	99
			W		
59	12	62 05.9	4 15.3	7	145
60	12	62 20.6	5 23.1	7	157
61	12	62 35.8	6 25.3	7	130
62	12	62 46.7	6 53.9	7	200
63	13	63 11.0	8 44.9	7	545
64	13	63 16.2	9 19.6	7	467
65	13	63 24.4	9 31.3	7	496
66	13	63 38.3	10 13.0	7	512
67	14	64 00.8	11 27.9	7	341

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1928	° ′	° ′		
		Atlantic Ocean			
68	July 14	64 04.8	11 38.3	7	341
69	14	63 58.7	12 19.1	8	470
70	14	63 47.6	13 17.1	8	859
71	15	63 29.9	14 14.0	8	1308
72	15	63 28.5	14 53.4	8	1239
73	15	63 25.2	15 17.9	8	1172
74	15	63 22.1	15 46.0	8	1005
75	15	63 16.0	16 17.2	8	929
76	16	63 15.0	16 33.0	8	571
77	16	63 26.1	17 06.7	8	137
78	16	63 20.2	17 14.5	8	99 ± 1
79	16	63 01.0	17 15.4	8	1284
80	16	62 47.0	17 08.7	8	1786
81	17	62 50.6	17 53.0	8	1284
82	17	62 57.2	18 23.1	8	1314
83	17	62 49.7	18 49.4	8	1239
84	17	62 32.7	19 04.7	8	1449
85	18	62 28.2	19 17.1	8	1421
86	18	62 45.2	19 37.2	8	1626
87	18	62 47.6	19 47.9	8	1705
88	18	62 36.9	19 55.2	8	1784
89	18	62 49.0	20 09.5	9	1344
90	18	63 02.7	20 32.2	9	782
91	18	63 08.8	20 45.2	9	241 ± 3
92	18	63 11.8	20 52.1	9	168 ± 2
93	18	63 14.8	20 59.5	9	136
94	19	63 17.7	21 19.3	9	160
95	19	63 17.8	21 34.2	9	162 ± 2
96	19	63 24.7	21 43.1	9	142
97	19	63 37.8	22 00.8	9	143 ± 2
98	27	63 44.4	23 39.8	9	159
99	28	62 47.7	25 49.6	9	868 ± 10
100	28	62 31.4	26 18.1	9	1174[f]
101	28	62 31.4	26 18.1	9	1102[f]
102	28	62 31.4	26 18.1	9	1123[f]
103	28	62 12.4	27 09.4	9	1363
104	28	61 56.6	27 51.8	9	1312
105	28	61 39.7	28 35.4	9	1586
106	29	61 21.0	29 22.0	9	1841
107	29	61 00.6	30 15.6	10	1756
108	29	60 40.3	31 14.0	10	2138
109	29	60 20.0	32 10.1	10	2152
110	29	60 00.9	33 00.2	10	2397
111	30	59 43.2	33 43.2	10	2294
112	30	59 33.3	34 04.8	10	2329
113	30	59 21.5	34 15.8	10	3000
114	30	59 20.2	34 15.4	10	3030
115	30	59 14.8	34 13.8	10	2456
116	30	59 08.2	34 11.1	10	2368
117	30	59 01.2	34 08.3	10	2306 ± 25
118	30	58 54.1	34 05.7	10	2619
119	30	58 28.5	33 50.4	10	2566
120	31	58 50.6	33 55.3	10	2298
121	31	58 27.4	34 07.3	10	2217
122	31	58 06.4	34 14.2	10	1682
123	31	57 53.5	34 09.9	10	2284
124	31	57 49.9	33 59.2	11	2020
125	31	57 53.2	34 18.8	11	2193
126	31	57 59.1	34 57.1	11	2349
127	Aug. 1	58 05.5	35 39.8	11	2474
128	1	58 10.7	35 53.5	11	2633
129	1	58 15.2	35 50.0	11	2453
130	1	58 24.4	35 59.4	11	3063
131	1	58 25.2	36 01.4	11	3243 ± 75
132	2	58 18.5	38 01.8	11	3192
133	2	58 16.6	38 40.9	11	3212
134	2	58 14.4	39 31.3	11	3147
135	2	58 11.3	40 38.4	11	3220
136	2	58 07.7	41 51.6	11	3140
137	3	58 03.2	43 09.1	11	3281

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1928	° ′	° ′		
		Atlantic Ocean			
138	Aug. 3	57 58.5	44 25.0	11	3063
139	3	57 51.7	45 32.7	11	2604
140	3	57 21.9	46 21.8	12	3363
141	3	56 52.9	47 05.9	12	3607
142	4	56 15.0	47 47.0	12	3446
143	4	55 38.2	48 13.5	12	3626
144	4	55 02.6	48 39.0	12	3960
145	4	54 30.8	49 00.9	12	3589
146	4	53 41.1	49 16.4	12	3704
147	4	53 04.4	49 19.4	12	3507
148	4	52 42.9	49 23.5	12	3133
149	5	52 12.8	49 29.1	12	3199
150	5	51 42.7	49 32.1	12	2689
151	5	51 38.0	49 31.4	12	2592
152	5	51 04.3	49 09.9	12	1874
153	5	50 42.1	48 52.5	12	2170
154	6	48 58.1	48 21.2	12	2174
155	6	48 26.1	48 09.4	12	1969
156	6	47 51.9	48 00.2	13	287
157	6	47 19.5	47 54.6	13	199
158	7	46 06.3	48 01.7	13	137
159	7	45 50.9	47 51.0	14	665
160	7	45 26.8	47 35.1	14	2311
161	7	44 49.7	47 07.9	14	3701
162	8	43 29.7	46 51.4	14	4129
163	8	43 12.5	46 54.4	14	3866
164	8	42 57.2	46 55.1	14	3866
165	8	42 41.4	46 59.0	14	3953
166	9	42 09.7	47 10.4	14	4154
167	9	42 08.1	47 22.6	14	4056
168	9	41 54.8	47 33.2	14	3876
169	9	41 35.8	47 43.8	14	4069
170	10	39 40.2	48 49.1	15	5420 ±400
171	10	39 29.8	48 47.5	15	5031 ± 75
172	10	39 12.6	48 48.4	15	5420
173	11	38 39.9	48 50.2	15	5408
174	11	38 32.2	48 44.7	15	5179
175	11	38 18.5	48 43.7	15	4726
176	11	37 56.3	48 39.1	15	4741
177	12	37 33.4	48 35.9	16	4445
178	12	37 15.0	48 33.5	16	5208
179	12	37 09.1	48 31.2	16	5430
180	12	36 57.6	48 16.4	16	5189
181	12	36 51.8	47 52.9	16	5368
182	12	36 47.6	47 19.8	16	5039
183	13	36 46.2	46 35.9	16	5287 ± 40
184	13	36 32.0	46 03.4	16	4780
185	13	36 14.7	45 51.4	16	4967
186	14	35 56.4	45 31.0	16	4830 ±100
187	14	35 25.8	44 48.8	16	4731
188	14	35 01.5	43 48.2	17	4299
189	14	34 48.0	43 20.0	17	4373
190	15	33 41.2	42 22.4	17	4492
191	15	33 34.0	42 14.0	17	3651 ± 50
192	15	33 12.6	42 06.4	17	3729
193	15	32 50.4	41 55.3	17	3331
194	16	31 37.1	41 19.2	18	2294g
195	16	31 37.1	41 19.2	18	1990g
196	16	31 24.5	41 12.9	18	2339
197	16	31 13.7	41 06.5	18	3143
198	16	30 34.7	40 56.6	18	3367
199	16	30 18.8	40 50.4	18	3178
200	17	29 48.4	40 35.8	18	4054
201	17	29 30.7	40 27.8	18	3101
202	17	29 14.3	40 18.4	18	3722
203	18	28 17.4	39 49.8	18	3991
204	18	27 53.7	39 27.7	18	3697
205	18	27 38.6	39 11.2	18	4406
206	18	26 57.2	38 55.4	18	4800
207	19	25 48.0	38 49.3	19	4953
208	19	25 39.3	38 58.4	19	5193
209	19	25 25.0	39 12.1	19	4767
210	19	25 07.6	39 21.5	19	4408
211	20	24 00.2	39 34.9	19	5392

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1928	° ′	° ′		
		Atlantic Ocean			
212	Aug. 20	23 58.3	39 37.5	19	4522
213	20	23 38.3	39 44.4	19	5098
214	20	23 20.4	39 53.9	19	4408
215	21	21 18.5	39 27.5	20	5002
216	21	20 47.1	39 11.4	20	5207
217	22	19 10.1	38 27.8	20	5626
218	22	18 42.9	38 18.5	20	5346 ± 75h
219	23	16 12.3	37 51.1	21	5200
220	23	16 07.3	37 51.3	21	4996
221	24	15 52.4	37 53.9	21	4977
222	24	15 47.6	37 57.6	21	5238
223	24	15 43.2	38 00.1	21	5553
224	24	15 32.2	38 02.9	21	5443
225	25	15 04.9	38 06.9	21	4996
226	25	14 55.6	38 09.5	21	5783
227	25	14 53.0	38 11.3	21	5597
228	26	13 55.1	38 02.2	22	5141
229	27	13 25.7	38 00.2	22	5980
230	28	12 02.8	37 52.9	23	4957
231	28	11 43.0	37 50.4	23	5140
232	28	11 39.0	37 48.3	23	4836
233	29	10 50.9	37 24.8	23	4787
234	29	10 48.1	37 21.1	23	5159
235	30	9 20.8	36 56.6	24	4059
236	30	9 16.9	36 50.2	24	4338
237	31	8 16.0	36 11.7	24	3836 ±100
238	31	8 06.2	36 07.4	24	4688
239	31	7 57.4	36 01.0	24	3989
240	Sep. 1	9 31.6	36 39.2	24	4071
241	2	9 41.2	36 34.6	25	4392
242	2	10 03.8	36 44.7	25	4107
243	2	10 21.4	36 54.0	25	5064
244	3	11 00.3	37 06.7	25	4851
245	3	11 06.8	37 07.6	25	5100
246	3	11 18.5	37 09.2	25	4972
247	4	11 19.3	37 38.0	25	5215
248	4	11 23.2	38 03.4	25	5176
249	4	11 26.0	38 32.6	25	5215
250	4	11 26.7	39 03.0	26	4972
251	5	11 32.7	40 38.0	26	4492
252	5	11 32.6	40 49.9	26	4566
253	5	11 34.5	41 13.0	26	3753
254	5	11 36.2	41 29.6	26	4084
255	6	11 38.3	41 50.6	26	4025
256	6	11 39.7	42 05.6	26	4025
257	6	11 41.2	42 22.7	26	4379
258	6	11 40.3	42 36.4	27	3913
259	6	11 33.7	42 52.8	27	3441
260	6	11 29.0	43 30.7	27	3161
261	7	11 24.6	43 50.6	27	2948
262	7	11 21.2	44 07.5	27	2672
263	7	11 18.5	44 16.2	27	3077
264	7	11 20.4	44 27.8	27	3449
265	8	11 29.3	44 53.4	27	3676
266	8	11 34.8	45 14.9	27	4027
267	9	11 41.2	45 49.9	27	4098
268	9	11 44.6	46 15.7	27	3870
269	9	11 36.7	46 37.1	27	4836
270	10	11 50.7	47 17.0	28	4356
271	10	12 10.1	47 44.9	28	5013 ±100
272	10	12 27.5	48 13.3	28	4661
273	10	12 44.3	48 34.7	28	5105
274	11	12 53.5	49 00.4	28	4942
275	11	13 00.4	49 17.6	28	4890
276	11	13 07.6	49 34.9	28	4925
277	11	13 13.3	49 40.8	28	4822
278	11	13 13.0	49 51.8	28	4942
279	11	13 12.4	50 01.2	28	5086
280	12	13 08.9	50 36.4	28	4789
281	12	13 10.7	50 59.1	29	4823
282	13	13 12.7	51 27.7	29	4977
283	13	13 14.7	52 12.5	29	5068
284	13	13 17.0	52 20.6	29	5032

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1928	° '	° '		
		Atlantic Ocean			
285	Sep. 13	13 15.4	52 40.3	29	5142
286	13	13 12.9	52 57.3	29	5086
287	14	13 10.7	53 19.8	29	4960
288	14	13 09.4	53 35.3	29	5032
289	14	13 06.7	53 55.6	29	5219
290	14	13 02.4	54 19.8	30	5123
291	14	13 00.9	54 41.7	30	5032
292	14	12 58.6	55 05.6	30	4757
293	15	12 56.9	55 30.5	30	4612
294	15	12 55.6	55.50.1	30	4631
295	15	12 54.0	56 12.2	30	4709
296	15	12 54.1	56 13.5	30	4709
297	15	12 54.5	56 18.7	30	4709
298	15	12 55.9	56 40.4	30	4615
299	15	12 56.8	56 59.9	30	4677
300	16	13 01.1	58 08.8	30	2776
301	16	13 00.6	58 29.3	30	2389
302	16	13 01.0	58 47.2	30	2108
303	Oct. 1	13 14.0	59 48.2	30	1139
304	1	13 27.1	60 02.3	30	1670
305	1	13 35.5	60 12.9	30	1865
306	2	14 30.2	61 07.2	31	897
307	2	14 41.3	61 23.6	31	2462
308	2	14 43.4	61 56.0	31	2790
309	2	14 45.0	62 24.8	31	2790
310	3	14 46.0	63 24.5	31	1635
311	3	14 46.3	63 36.4	31	1323
312	3	14 48.5	63 56.6	31	2462
313	3	14 51.1	64 26.3	31	3592
314	4	14 58.8	65 47.1	31	4752
315	4	15 01.3	66 06.9	32	3582
316	4	15 03.9	66 31.0	32	4938
317	5	15 16.7	68 08.4	32	4566[h]
318	6	15 06.5	71 38.7	32	3849
319	7	14 31.9	73 58.8	33	3949
320	7	14 17.4	74 31.8	33	4112
321	8	13 36.9	76 19.9	33	4040
322	8	13 34.1	76 28.1	33	4040
323	8	13 10.4	76 50.9	33	3960
324	8	12 48.0	77 12.5	33	3926
325	9	11 42.3	78 18.8	34	3716
326	9	11 23.5	78 30.8	34	3537
327	9	11 15.2	78 36.5	34	3537
328	10	10 21.6	79 10.2	34	3058
329	10	10 15.2	79 14.1	34	3018 ± 35
330	10	9 58.7	79 24.4	34	2283
331	10	9 45.7	79 35.7	34	608
		Pacific Ocean			
332	Oct. 25	7 48.5	79 37.9	35	133
333	26	6 35.1	79 56.7	35	3583 ± 50
334	26	6 33.2	80 01.9	35	3583 ± 50
335	26	6 19.1	80 13.5	35	3211 ± 50
336	26	6 15.1	80 12.7	35	3287 ± 40
337	27	5 25.1	79 59.1	35	3408 ± 50
338	27	5 21.6	79 58.4	35	3904
339	28	4 15.9	79 40.4	36	2888
340	28	4 14.9	79 38.8	36	3244
341	28	4 10.9	79 47.3	36	2919
342	28	4 16.2	79 48.1	36	2876
343	29	4 07.9	79 52.6	36	3632 ±150
344	30	2 54.0	80 03.7	36	4880
345	30	2 57.0	80 30.2	36	3107 ± 35
346	30	3 19.9	80 53.8	36	3073 ± 35
347	31	4 13.6	81 30.6	36	1690
348	31	4 31.8	81 47.3	37	1918
349	31	4 55.6	82 06.7	37	1301
350	31	5 05.8	82 14.3	37	2136
351	31	5 13.6	82 21.3	37	3212 ± 40
352	31	5 18.6	82 30.3	37	3662
353	Nov. 1	5 57.7	82 55.6	37	3494

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1928	° '	° '		
		Pacific Ocean			
354	Nov. 1	5 58.8	82 55.9	37	3304
355	1	6 03.3	82 58.9	37	3443
356	1	5 40.9	83 04.0	37	3494 ± 45
357	2	4 37.9	82 16.7	38	3886 ± 40
358	2	4 36.7	82 17.3	38	3997
359	3	3 45.1	81 39.9	38	2520
360	3	3 46.7	81 34.3	38	2371 ± 25
		S			
361	14	2 01.9	94 43.0	43	3596
362	15	2 30.0	95 42.7	43	3560
363	15	2 43.8	96 35.2	43	3503
364	16	3 00.4	97 56.0	44	3779
365	16	3 06.6	98 51.9	44	3554
366	17	3 15.1	99 45.5	44	4232
367	17	3 26.0	100 52.4	44	3668
368	18	3 51.8	102 10.6	44	3523
369	18	4 14.6	103 35.7	45	3286
370	19	4 36.3	105 00.2	45	3342
371	19	5 20.7	105 44.9	45	3233
372	20	6 32.9	106 35.6	45	3270
373	20	7 46.4	107 26.4	46	3161
374	21	9 06.0	108 18.3	46	2873
375	22	11 29.4	109 54.9	46	2873
376	22	12 48.1	110 54.4	47	2873
377	23	14 07.2	111 48.5	47	2873
378	23	14 58.2	112 16.4	47	2816
379	24	16 51.4	113 05.6	48	2817
380	24	17 35.1	113 24.8	48	3048
381	25	19 05.9	114 05.6	48	2874
382	25	20 04.7	114 10.2	48	3068
383	26	21 30.0	114 22.3	49	2945
384	26	22 21.9	114 31.6	49	2908
385	27	23 15.6	114 43.5	49	3053
386	27	23 50.7	114 50.5	49	2981
387	28	24 30.3	115 15.2	49	3126
388	28	25 23.5	115 33.4	50	2908
389	29	26 26.6	115 20.9	50	2837
390	29	27 14.6	115 12.5	50	3198
391	30	27 58.6	115 08.7	51	3233
392	30	28 35.9	114 59.5	51	3161
393	Dec. 1	29 05.4	114 47.2	51	3027
394	1	29 41.5	114 35.6	51	3233
395	2	30 19.2	114 20.6	51	3256
396	2	31 04.7	113 55.2	52	3008
397	3	31 27.0	112 51.3	52	2777
398	3	31 33.8	111 55.1	52	2797
399	4	31 37.4	110 32.5	53	2871
400	4	30 35.2	109 13.4	53	2835
401	5	29 07.4	108 46.5	53	2871
402	5	28 56.9	108 52.1	53	2908
403	12	27 25.3	109 25.1	54	2692
404	13	28 00.9	109 09.6	54	2726
405	13	28 42.9	109 03.3	54	2870
406	14	29 16.0	108 53.8	54	3015
407	15	30 53.0	109 28.1	55	3013
408	15	31 34.0	109 54.9	55	3086
409	16	32 03.3	110 53.4	55	2725
410	16	31 55.5	110 02.1	55	3375
411	17	31 50.9	109 37.1	56	2652
412	17	31 39.9	109 07.3	56	3302
413	18	31 47.5	109 05.1	56	3266
414	18	32 13.0	108 11.2	56	3079
415	19	32 21.3	107 27.0	56	3266
416	19	33 02.9	107 09.4	57	3156
417	20	33 58.4	106 42.1	57	3156
418	20	34 27.2	106 20.7	57	3301
419	21	34 57.0	105 42.8	57	3084
420	21	35 54.3	104 49.2	58	2937
421	22	36 48.7	104 03.8	58	3810
422	22	37 23.7	103 50.9	58	3808
423	23	38 22.1	103 13.1	59	3880

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude S	Longitude W	Station no.	Depth in meters
	1928	° ′	° ′		
		Pacific Ocean			
424	Dec.23	39 09.8	102 15.7	59	3807
425	24	39 48.0	101 05.3	59	4172
426	24	40 02.7	100 19.5	59	3953
427	25	40 16.2	99 21.4	59	4246
428	25	40 18.4	98 10.5	60	4170
429	26	40 22.5	97 34.0	60	3915
430	26	40 21.9	97 02.0	60	3661
431	27	40 05.7	96 32.5	60	3655
432	27	39 18.5	95 18.5	61	3692
433	28	38 30.2	94 15.7	61	3370
434	28	37 45.0	93 40.8	61	2936
435	29	36 58.2	93 13.7	61	3370
436	29	35 51.6	92 38.1	62	3808
437	30	34 34.8	91 52.4	62	3662
438	31	32 35.0	90 06.7	63	3681
439	31	32 30.2	90 01.0	63	3664
440	31	32 26.2	89 50.9	63	3441
441	31	32 23.7	89 43.5	63	3441
	1929				
442	Jan. 1	32 09.8	89 04.6	63	3157
443	1	32 09.9	89 04.4	63	3301
444	1	32 05.6	88 58.3	63	3012
445	2	31 57.5	88 49.6	63	3129
446	2	31 48.6	88 25.6	64	3520
447	3	31 53.7	88 17.5	64	3717
448	3	31 53.0	87 57.2	64	3228
449	4	31 50.2	87 30.6	64	3737
450	4	31 33.0	86 58.4	65	3615
451	5	31 08.9	86 40.5	65	3542
452	5	31 07.8	86 39.5	65	3505
453	5	30 24.3	86 11.7	65	3716
454	6	29 16.2	85 34.5	65	3266
455	6	28 11.3	84 54.3	66	3812
456	7	27 06.1	83 59.6	66	3812
457	7	26 12.6	83 15.1	66	3958
458	8	25 03.2	82 20.0	67	1473
459	8	24 57.9	82 14.6	67	1224
460	8	24 54.0	82 13.0	67	1275
461	8	24 48.3	82 09.3	67	2725
462	8	24 38.8	82 03.7	67	3557
463	8	24 28.6	81 57.8	67	4011
464	8	24 17.6	81 51.6	67	4026
465	9	23 24.9	81 22.2	67	4214
466	9	22 30.1	80 57.8	68	4216
467	10	21 28.6	80 24.1	68	4128
468	10	20 46.6	80 07.0	68	3812[d]
469	11	18 17.2	79 03.5	69	3050
470	12	16 50.3	78 37.5	69	3684
471	12	15 56.7	78 25.5	69	3740
472	13	14 29.6	78 00.1	70	4225
473	13	13 54.5	77 52.4	70	4842[d]
474	13	13 38.1	77 51.4	70	5324
475	14	12 37.9	77 24.1	70	642
476	Feb. 6	11 59.0	78 34.4	71	2952 ±150
477	6	11 39.5	78 51.2	71	3702
478	6	11 19.5	79 05.7	71	3965
479	7	10 26.0	79 44.9	71	4256
480	7	10 08.4	79 58.2	71	4987
481	7	10 05.8	80 21.1	72	5657
482	7	10 04.5	80 41.1	72	5042
483	7	10 03.5	81 03.6	72	4782
484	8	10 00.0	82 02.5	72	4717
485	8	9 56.2	82 13.3	72	4549
486	8	10 00.7	82 58.4	72	4363
487	9	10 17.0	83 59.1	73	4490
488	9	10 25.9	84 14.7	73	4476
489	9	10 31.9	84 28.9	73	4639
490	10	10 42.8	84 53.3	73	4505
491	10	10 45.2	84 57.7	73	4670
492	10	10 38.6	85 19.6	73	4534
493	11	10 34.9	85 44.7	73	4336
494	11	10 41.1	86 11.4	74	4243
	1929	° ′	° ′		
		Pacific Ocean			
495	Feb.12	10 58.5	87 13.6	74	4322
496	12	11 00.1	87 23.1	74	4309
497	12	11 12.6	87 46.1	74	4391
498	12	11 28.3	88 10.6	74	4130
499	12	11 41.1	88 26.9	74	4296
500	13	12 15.5	89 10.2	74	4296
501	13	12 30.0	89 34.9	74	4336
502	13	12 45.5	90 02.3	75	4335
503	13	13 03.7	90 31.3	75	4129
504	13	13 28.8	91 03.5	75	4093
505	14	14 09.2	91 55.3	75	4022
506	14	14 15.4	92 04.4	75	3693
507	14	14 20.0	92 12.2	75	3888
508	14	14 41.8	92 41.8	75	3570
509	14	14 52.7	92 59.2	75	3999
510	14	15 15.7	93 30.7	75	4070
511	15	15 53.9	94 23.2	75	3965
512	15	15 50.9	94 46.4	76	4271
513	15	15 45.0	95 12.1	76	3890
514	15	15 38.9	95 42.1	76	3838
515	15	15 32.2	96 13.5	76	3754
516	16	15 19.9	97 15.2	76	3591
517	16	15 17.7	97 26.3	76	3197
518	16	15 16.7	97 33.5	76	3343
519	16	15 09.5	98 08.3	76	5008
520	16	15 07.3	98 19.7	76	4284
521	16	15 07.0	98 21.2	76	3858
522	16	15 04.1	98 32.8	76	3637
523	16	14 58.0	99 03.4	76	3715
524	17	14 38.8	100 09.5	76	3734 ± 50
525	17	14 47.6	100 38.6	77	4169
526	17	14 43.6	101 11.2	77	4323
527	17	14 36.5	101 48.4	77	4001
528	17	14 32.1	102 09.7	77	4243
529	18	14 21.2	103 02.5	77	4036
530	18	14 17.3	103 25.4	77	3934
531	18	14 13.3	103 46.0	77	3571
532	18	14 07.8	104 02.3	77	4256
533	18	14 00.6	104 24.9	77	4194
534	19	13 43.7	105 21.0	77	3878
535	19	13 16.4	107 10.0	78	3621
536	20	13 03.5	107 54.8	78	3471
537	20	13 00.2	108 09.1	78	3480
538	20	12 56.1	108 24.3	78	3488
539	20	12 51.3	108 44.6	78	3373
540	20	12 46.0	109 02.7	78	3429
541	21	12 39.5	109 24.7	78	3455
542	21	12 34.6	109 41.1	78	3117
543	21	12 31.1	110 05.4	78	3265
544	21	12 34.0	110 54.7	79	2822 ± 15
545	21	12 34.4	111 16.5	79	2805
546	22	12 34.9	111 46.9	79	2967 ± 15
547	22	12 35.3	112 09.0	79	3063
548	22	12 35.8	112 20.4	79	3200
549	22	12 36.1	112 38.5	79	3103
550	22	12 34.5	113 02.3	79	3255
551	22	12 33.8	113 32.5	79	3200
552	23	12 33.4	114 09.2	79	3348
553	23	12 33.2	114 36.1	79	3437
554	23	12 30.7	115 01.2	80	3414
555	23	12 32.4	115 33.8	80	3244
556	23	12 31.9	115 57.8	80	3514
557	23	12 32.5	116 25.8	80	3497
558	24	12 35.6	116 57.7	80	3430
559	24	12 38.0	117 17.6	80	3471
560	24	12 40.2	117 28.0	80	3541
561	24	12 43.6	117 50.5	80	3725
562	24	12 43.6	118 10.6	80	3687
563	24	12 44.2	118 29.8	80	2616
564	25	12 45.0	118 51.6	80	3558
565	25	12 45.5	119 06.0	80	3594
566	25	12 44.0	119 20.1	81	3774
567	25	12 54.3	119 38.7	81	3794

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude S	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
568	Feb.25	13 02.8	119 55.8	81	3668
569	25	13 02.8	120 19.7	81	3616
570	26	13 02.8	120 44.4	81	3350
571	26	13 02.9	121 06.1	81	3744
572	26	13 02.8	121 10.6	81	3179
573	26	13 02.6	121 14.7	81	3612
574	26	13 04.1	121 37.7	31	3602
575	26	13 06.6	122 17.0	81	3422
576	26	13 07.4	122 36.5	81	3835
577	27	13 06.5	123 06.4	81	3705
578	27	13 05.4	123 37.6	81	3774
579	27	13 22.9	124 03.2	82	3686 ± 20
580	27	13 43.0	124 31.9	82	4006
581	27	14 01.9	124 57.1	82	3844
582	27	14 14.3	125 13.7	82	3372
583	28	14 31.0	125 36.3	82	4030
584	28	14 48.1	125 59.2	82	3907
585	28	14 53.5	126 11.6	82	3567
586	28	15 06.2	126 25.4	82	3773
587	28	15 41.9	127 05.3	82	3929
588	Mar. 1	15 58.8	127 24.8	82	4207
589	1	16 13.3	127 41.6	82	3994
590	1	16 29.0	128 00.3	83	4008
591	1	16 45.4	128 18.1	83	3931
592	1	16 55.8	128 37.3	83	4053
593	1	16 56.9	128 55.0	83	3986
594	2	16 58.2	129 16.4	83	3986
595	2	16 59.5	129 37.4	83	3986
596	2	17 00.2	129 44.5	83	4008
597	2	17 00.9	129 48.8	83	3986
598	2	16 59.7	130 01.5	83	3931
599	2	17 01.9	130 23.3	83	4184
600	2	17 03.6	130 43.3	83	4171
601	3	17 06.2	131 03.7	83	3898
602	3	17 08.9	131 22.6	83	4233
603	3	17 07.8	131 38.8	84	4259
604	3	17 07.1	131 57.4	84	4233
605	3	17 08.3	132 19.3	84	4377
606	3	17 08.9	132 33.4	84	4220
607	4	17 09.6	132 51.6	84	4233
608	4	17 10.2	133 11.0	84	4335
609	4	17 11.1	133 17.1	84	4112
610	4	17 12.1	133 20.8	84	4042
611	4	17 09.9	133 33.4	84	4259
612	4	17 09.2	133 52.5	84	4324
613	4	17 08.5	134 16.6	84	4377
614	5	17 07.9	134 37.5	84	4335
615	5	17 07.2	134 57.2	85	4391
616	5	17 04.9	135 17.4	85	4325
617	5	17 02.6	135 33.5	85	4172
618	5	17 06.2	135 56.4	85	4286
619	5	17 07.8	136 09.2	85	4042
620	6	17 09.4	136 22.0	85	3921
621	6	17 10.9	136 33.8	85	3756
622	6	17 11.6	136 36.4	85	3765
623	6	17 12.9	136 37.4	85	3796
624	6	17 14.0	136 59.2	85	3756 ± 30
625	6	17 15.0	137 26.6	85	2934 ± 20
626	6	17 14.9	137 31.3	85	3321 ± 25
627	6	17 14.7	137 37.3	85	3376 ± 20
628	6	17 14.6	137 43.3	85	3210 ± 25
629	6	17 14.4	137 49.3	85	3093 ± 30
630	7	17 14.5	137 54.9	85	2911 ± 25
631	7	17 14.6	138 00.5	85	2847 ± 20
632	7	17 14.9	138 06.3	85	1800 ± 15
633	7	17 15.3	138 11.9	85	1482
634	7	17 15.8	138 14.3	85	1358
635	7	17 16.4	138 18.1	85	1629 ± 10
636	7	17 17.7	138 24.1	85	919
637	7	17 20.0	138 28.4	85	1022
638	7	17 22.6	138 45.3	85	2336
639	7	17 28.3	139 12.4	85	2761

Sounding no.	Date	Latitude S	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
640	Mar. 7	17 31.4	139 25.6	86	3053
641	7	17 34.2	139 38.1	86	3384
642	7	17 34.4	139 49.6	86	3551
643	7	17 34.9	140 02.5	86	3299
644	8	17 35.0	140 15.0	86	3670 ± 25
645	8	17 35.3	140 29.8	86	3614
646	8	17 35.9	140 36.6	86	2082 ± 15
647	8	17 37.6	140 42.0	86	1686 ± 10
648	8	17 42.2	140 46.7	86	1810 ± 15
649	8	17 46.1	140 49.2	86	1094
650	8	17 47.7	140 49.4	86	290 ± 5
651	8	17 49.2	140 54.9	86	2570
652	8	17 51.7	141 02.2	86	3473
653	8	17 49.8	141 11.7	86	3569
654	8	17 47.0	141 19.0	86	3578
655	9	17 40.2	141 36.8	86	1553
656	9	17 36.9	141 45.1	86	2591
657	9	17 35.9	141 51.1	86	2542
658	9	17 35.9	141 54.7	86	2024
659	9	17 36.1	142 02.5	86	2267
660	9	17 38.9	142 11.1	86	2073
661	9	17 41.8	142 19.9	86	1874
662	9	17 44.5	142 27.0	86	2192
663	9	17 53.2	142 46.8	86	4363 ± 30
664	10	18 03.5	143 09.7	86	4021 ± 22
665	10	18 05.7	143 23.6	86	4031 ± 50
666	10	18 04.7	143 36.2	86	4055 ± 30
667	10	18 02.8	143 58.4	87	4185
668	10	17 58.2	144 45.5	87	2583
669	10	17 57.3	144 57.7	87	2395
670	11	17 59.1	145 14.8	87	4324 ± 26
671	11	18 03.8	145 27.7	87	4310
672	11	18 04.4	145 32.3	87	4272
673	11	18 05.3	145 39.9	87	4185
674	11	18 10.5	146 03.2	87	4233
675	11	18 13.4	146 27.4	87	4196
676	11	18 07.8	146 47.8	87	4350 ± 25
677	12	17 57.0	147 31.0	87	4196 ± 35
678	12	17 52.3	147 55.3	87	2836 ± 30
679	12	17 47.6	148 18.2	87	3660 ± 20
680	12	17 40.5	148 47.0	87	3305 ± 25
681	12	17 37.9	148 58.0	87	2940 ± 20
682	12	17 34.9	149 09.0	87	2430 ± 20
683	13	17 31.2	149 17.0	87	994 ± 11
684	20	17 26.8	149 41.1	88	1765 ± 10
685	20	17 23.4	149 46.3	88	2423
686	20	17 17.2	149 56.0	88	2809 ± 15
687	20	17 08.7	150 05.5	88	3765 ± 20
688	20	17 01.5	150 12.8	88	3806 ± 20
689	21	16 48.3	150 29.1	88	2929 ± 18
690	21	16 40.8	150 41.9	88	3697
691	21	16 58.2	150 50.4	88	3001 ± 20
692	22	17 10.6	151 18.1	88	3276 ± 20
693	22	17 17.5	151 39.8	88	3765 ± 30
694	22	17 35.6	151 45.5	89	3987
695	22	17 39.5	151 51.4	89	3717
696	22	17 32.1	152 02.3	89	4021 ± 25
697	23	17 20.6	152 13.6	89	4021 ± 25
698	23	17 08.0	152 40.8	89	4286
699	23	17 04.6	152 57.7	89	4473
700	24	16 56.7	153 20.7	89	4124 ± 60
701	24	16 53.0	153 43.4	89	2128
702	24	16 51.6	153 50.3	89	2684
703	24	16 51.6	153 56.1	89	982
704	24	16 48.9	154 29.8	90	4137
705	24	16 46.1	154 44.3	90	3642
706	25	16 38.9	155 22.2	90	4530 ± 30
707	25	16 36.1	155 36.3	90	4603
708	25	16 32.0	156 01.3	90	4678
709	25	16 27.5	156 19.1	90	4618
710	25	16 21.2	156 56.9	90	4955
711	26	16 18.0	157 17.5	90	4678 ± 25
712	26	16 12.4	157 52.1	90	5007

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude S	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
713	Mar 26	16 03.2	158 46.3	91	4920
714	26	15 58.3	159 06.7	91	5133
715	26	15 53.1	159 33.3	91	5042
716	27	15 49.3	159 52.1	91	4954 ± 32
717	27	15 44.3	160 19.0	91	4937
718	27	15 40.2	160 45.0	91	4853
719	27	15 39.1	160 55.2	91	5042 ± 30
720	27	15 38.4	161 03.6	91	4772
721	27	15 37.3	161 14.1	91	4903
722	28	15 35.9	161 25.2	91	4954 ± 30
723	28	15 33.4	161 44.4	91	4221 ± 30
724	28	15 31.6	162 01.1	92	5403 ± 75
725	28	15 28.0	162 20.3	92	5640 ± 30
726	29	15 23.5	162 43.6	92	5424 ± 40
727	29	15 17.5	163 13.2	92	5530
728	29	15 12.1	163 37.4	92	5487 ± 30
729	29	15 06.1	163 59.1	92	5618
730	29	15 00.6	164 21.7	92	5343 ± 50
731	30	14 54.6	164 46.3	92	4988 ± 45
732	30	14 48.9	165 09.4	92	5597 ± 45
733	30	14 42.8	165 36.0	93	5686 ± 45
734	30	14 41.6	166 11.4	93	5386
735	30	14 41.8	166 36.0	93	5405
736	31	14 41.7	167 08.5	93	5325 ± 40
737	31	14 41.1	167 39.9	93	5208
738	31	14 41.4	167 53.3	93	5227
739	31	14 41.0	168 15.0	93	4378
740	31	14 40.3	168 35.0	93	4954 ± 35
741	31	14 39.1	168 50.1	93	4903 ± 30
742	Apr. 1	14 37.3	169 02.9	93	4920 ± 50
743	1	14 31.3	169 33.8	93	3807 ± 25
744	1	14 26.7	169 57.9	93	2315 ± 35
745	1	14 21.0	170 22.8	93	1829 ± 10
746	1	14 19.3	170 29.5	93	1811 ± 10
747	1	14 18.3	170 34.0	93	76 ± 1
748	5	14 16.0	170 54.9	93	1917 ± 10
749	5	14 07.8	171 02.8	93	3689 ± 25
750	5	14 03.5	171 07.1	93	3517 ± 20
751	5	14 00.3	171 10.1	93	3483 ± 20
752	5	13 56.4	171 13.9	93	2293
753	6	13 53.2	171 18.0	93	1159
754	20	13 26.9	171 42.2	94	3624
755	21	12 46.2	171 44.4	94	4771
756	21	13 41.9	171 44.4	94	859 ± 15
757	21	13 25.5	171 43.1	94	3787
758	22	13 15.1	171 40.5	94	4573
759	22	12 50.3	171 34.1	94	4740 ± 30
760	22	12 43.6	171 36.6	94	4835
761	22	12 24.6	171 35.5	94	4887
762	22	12 17.2	171 52.3	94	4788
763	23	12 08.3	171 56.2	94	4788
764	23	11 12.4	171 33.0	94	4740
765	23	10 48.8	171 22.2	94	4902 ± 25
766	23	10 20.2	171 13.4	95	4789
767	23	9 52.4	171 04.6	95	4043
768	24	9 31.8	170 58.9	95	3560
769	24	9 22.8	170 58.0	95	3517
770	24	8 51.0	170 54.0	95	4298 ± 25
771	24	8 27.0	171 12.0	95	4473
772	24	8 12.5	171 20.2	95	4789
773	25	8 01.7	171 30.2	95	5043
774	25	7 58.4	171 48.8	95	4574
775	25	7 41.6	171 49.5	96	5227 ± 35
776	25	7 23.5	171 54.5	95	5286 ± 35
777	25	6 51.3	172 07.8	96	5286
778	26	6 44.2	172 17.6	96	5246 ± 36
779	26	6 45.9	172 22.2	96	5325
780	26	6 30.8	172 25.3	96	5266 ± 35
781	26	6 14.2	172 24.9	96	5531
782	26	5 57.0	172 24.3	96	5598 ± 55
783	27	5 24.5	172 24.5	96	5733
784	27	5 10.5	172 23.6	97	5708 ± 30

Sounding no.	Date	Latitude S	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
785	Apr. 27	4 54.6	172 24.1	97	5424
786	27	4 40.1	172 27.8	97	5076
787	27	4 29.9	172 31.5	97	5115 ± 75
788	28	4 20.4	172 33.0	97	5132 ± 55
789	28	3 46.6	172 36.9	97	5324
790	28	3 33.0	172 43.6	97	5640
791	28	3 10.9	172 56.2	97	5385
792	28	2 54.3	173 07.2	97	5343 ± 40
793	29	2 41.8	173 16.1	97	5245 ± 36
794	29	2 16.3	173 25.0	97	5226
795	29	1 51.4	173 28.4	97	5364
796	29	1 25.4	173 33.7	98	5209
797	29	1 00.9	173 39.1	98	5511
798	29	0 44.6	173 43.2	98	5490 ± 30
799	30	0 27.7	173 47.7	98	5532
		N			
800	30	0 18.1	173 57.3	98	5599 ± 30
801	30	0 42.7	174 09.3	98	5555 ± 35
802	30	1 10.2	174 22.5	98	5532
803	30	1 29.9	174 33.6	98	5577 ± 30
804	May 1	1 42.1	174 40.6	98	5448 ± 40
805	1	2 04.4	174 53.6	98	5345
806	1	2 23.9	175 02.8	99	5349
807	1	2 47.4	175 17.3	99	5363 ± 30
808	1	3 08.8	175 33.7	99	4802 ± 30
809	1	3 31.5	175 49.6	99	4900 ± 35
810	2	4 18.8	176 16.4	99	4900
811	2	4 23.1	176 19.5	99	4951 ± 30
812	2	4 42.7	176 37.7	99	5094 ± 60
813	3	5 55.9	177 18.7	99	4661 ± 30
814	3	6 24.1	177 40.5	100	3973 ± 25
815	3	6 51.9	177 58.2	100	4615 ± 30
816	3	7 08.6	178 08.7	100	5363 ± 40
817	3	7 24.3	178 19.8	100	5573
818	4	7 33.6	178 26.5	100	5872 ± 46
819	4	7 59.5	178 43.3	100	5800 ± 30
820	4	8 21.9	179 06.8	100	5800 ± 30
821	4	8 49.8	179 30.1	100	5971 ± 50
822	4	9 13.6	179 40.7	100	5946
823	5	9 27.5	179 46.9	100	6022 ± 48
			E		
824	5	10 12.9	179 47.4	100	6290 ± 50
825	5	12 09.3	178 26.3	101	5997 ± 50
826	7	12 32.4	178 09.1	101	5849 ± 75
827	7	13 15.8	177 35.8	101	5663 ± 50
828	7	13 23.1	177 24.3	101	5663
829	7	13 47.0	177 01.9	101	5552
830	7	14 19.7	176 21.2	101	4194
831	7	14 29.9	176 08.0	101	3844 ± 20
832	8	14 38.0	175 57.6	101	4040
833	8	15 08.2	175 18.6	101	4527
834	8	15 19.4	174 51.3	101	5303
835	8	15 33.0	174 18.6	102	5446
836	8	15 44.0	173 47.6	102	5364
837	8	15 55.7	173 17.2	102	5446
838	9	16 01.1	173 03.5	102	5488
839	9	16 22.0	172 10.2	102	3919
840	9	16 24.8	171 58.9	102	5245
841	9	16 43.7	171 28.2	102	4245
842	9	17 20.1	170 42.3	102	5324 ± 50
843	9	17 31.5	170 27.3	102	5059 ± 35
844	10	17 48.5	170 05.0	102	5076
845	10	18 10.2	169 36.7	102	5245
846	10	18 26.0	169 06.5	103	5267
847	10	18 34.8	168 36.7	103	5171
848	10	18 44.9	168 13.4	103	5116 ± 35
849	11	18 57.5	167 40.9	103	4806 ± 35
850	11	19 04.7	167 22.4	103	4137
851	11	19 10.4	167 08.1	103	4633
852	11	19 15.3	166 54.9	103	4486
853	11	19 18.4	166 44.5	103	3391
854	11	19 17.4	166 41.8	103	2587

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude N	Longitude E	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
855	May 11	19 16.5	166 39.0	103	1204
856	11	19 15.9	166 37.7	103	233 ± 4
857	11	19 16.6	166 33.0	103	970
858	11	19 17.7	166 30.1	103	2399
859	11	19 18.8	166 26.5	103	3708 ± 20
860	11	19 21.5	166 16.2	103	5247
861	11	19 34.6	165 47.6	103	5153
862	11	19 47.4	165 17.0	103	5326
863	12	19 58.9	164 49.6	103	4486
864	12	20 11.0	164 21.1	103	5406
865	12	20 16.8	163 48.1	104	3432
866	12	20 16.2	163 17.7	104	1559
867	12	20 16.0	163 12.5	104	1426 ± 10
868	12	20 16.0	163 05.4	104	1341 ± 10
869	12	20 15.8	162 58.8	104	1295 ± 10
870	12	20 15.6	162 51.1	104	3014
871	12	20 15.6	162 50.0	104	3254 ± 20
872	12	20 15.2	162 36.5	104	4920
873	12	20 14.6	162 16.4	104	4955
874	13	20 12.3	161 26.1	104	4741 ± 30
875	13	20 13.3	160 46.3	104	1840
876	13	20 13.3	160 39.6	104	2750
877	13	20 13.3	160 32.2	104	3670
878	13	20 13.1	160 13.8	104	5153
879	13	20 13.1	159 48.6	104	5387
880	14	19 59.9	159 21.6	104	5406
881	14	19 49.7	159 00.6	104	5490
882	14	19 34.8	158 35.9	105	5642 ± 30
883	14	19 18.9	157 58.0	105	4273
884	14	19 09.3	157 34.3	105	5532
885	14	19 02.6	157 14.1	105	5642
886	15	18 45.1	156 25.4	105	5665
887	15	18 42.6	156 11.8	105	5576
888	15	18 30.0	155 40.3	105	5532 ± 40
889	15	18 15.3	155 07.9	105	5621 ± 40
890	15	18 03.3	154 41.2	105	5532 ± 40
891	16	17 42.6	153 52.1	105	5676 ± 50
892	16	17 28.8	153 26.5	106	5024
893	16	17 18.9	153 07.5	106	4445 ± 30
894	16	17 18.2	153 06.1	106	4589
895	16	17 03.1	152 40.5	106	5511 ± 50
896	16	16 49.3	152 13.4	106	2911
897	17	16 15.7	151 10.0	106	5925 ± 30
898	17	16 01.5	150 37.9	106	5780 ± 30
899	17	15 43.5	150 02.9	106	5621
900	17	15 30.7	149 34.5	106	3345
901	18	15 08.7	148 45.4	106	5711
902	18	14 57.1	148 19.4	107	5096 ± 35
903	18	14 40.3	147 49.6	107	2791 ± 20
904	18	14 31.6	147 28.1	107	7776 ± 75
905	18	14 24.0	147 05.2	107	7448 ± 75
906	19	14 15.2	146 38.7	107	4970
907	19	14 06.9	146 14.4	107	4920
908	19	13 58.6	145 45.4	107	3736
909	19	13 53.2	145 30.8	107	2688
910	19	13 50.0	145 16.9	107	2034
911	19	13 45.6	144 58.6	107	646
912	20	13 39.7	144 46.5	107	746 ± 5
913	25	14 12.7	144 26.9	108	3999
914	26	15 36.0	144 10.3	108	4236
915	26	15 55.8	144 07.6	108	3091
916	26	16 34.9	144 05.6	108	4517 ± 25
917	26	16 58.0	144 05.2	108	4339
918	26	17 24.6	144 04.6	108	4274
919	27	17 50.5	144 04.0	108	4605
920	27	18 19.4	144 03.2	108	4068
921	27	18 28.2	143 59.0	108	4326
922	27	18 54.3	143 58.3	108	3848
923	27	19 40.9	144 01.5	108	3361
924	28	20 25.0	144 05.2	108	3270
925	28	21 00.8	144 08.1	109	3090
926	28	21 23.9	144 11.5	109	2259 ± 15
927	28	21 48.6	144 13.2	109	2763 ± 15

Sounding no.	Date	Latitude N	Longitude E	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
928	May 28	22 07.3	144 14.5	109	3358
929	28	22 23.9	144 13.7	109	3753
930	29	22 52.2	144 12.3	109	2535 ± 25
931	29	23 16.0	144 11.6	109	4935 ± 50
932	29	23 24.0	144 04.9	109	4988
933	29	23 42.1	144 01.9	109	7446 ± 50
934	29	23 49.9	144 00.3	109	8347
935	29	23 54.1	144 00.1	109	8323 ± 50
936	29	24 08.9	144 00.5	109	5777
937	29	24 16.9	144 00.9	109	5552 ± 30
938	30	24 55.3	144 02.9	110	3497
939	30	25 12.0	144 06.6	110	3319
940	30	25 26.5	144 10.5	110	3044
941	30	25 39.1	144 13.9	110	2605
942	30	25 50.4	144 16.9	110	2829 ± 15
943	31	26 19.7	144 24.4	110	3058
944	31	26 24.0	144 25.4	110	2733
945	31	26 34.8	144 23.8	110	3575
946	31	26 52.3	144 19.8	110	5187
947	31	27 14.1	144 14.6	110	5131
948	June 1	28 05.3	144 02.2	110	6180
949	1	28 23.9	144 02.0	110	6167
950	1	28 46.5	143 54.6	111	5845
951	1	29 11.5	143 50.7	111	5773
952	2	30 07.8	143 55.8	111	5704
953	2	30 23.5	144 10.0	111	5659
954	2	30 32.8	144 23.4	111	5845
955	3	30 58.3	144 14.0	111	5894
956	3	30 59.5	144 15.4	111	5881
957	3	31 20.6	144 06.0	111	5797
958	3	31 45.2	143 30.2	111	5869 ± 30
959	4	33 14.9	141 40.5	112	6739 ± 60
960	5	33 48.7	141 12.6	112	4285 ± 25
961	5	34 14.6	140 51.4	112	4677
962	5	34 34.1	140 17.5	112	3066 ± 20
963	25	34 38.1	140 58.2	113	2911
964	25	34 50.4	141 10.4	113	2935
965	25	35 18.9	141 19.4	113	1532
966	25	35 26.9	141 23.7	113	1428
967	26	35 45.6	141 41.9	114	2730
968	26	35 58.6	142 02.5	114	3167 ± 50
969	26	36 06.5	142 23.0	114	4257
970	26	36 13.9	142 40.3	114	6011
971	26	36 22.1	142 59.5	114	7656 ± 60
972	27	36 30.0	143 17.6	114	6890
973	27	36 36.3	143 31.4	114	6758
974	27	36 39.4	143 34.4	114	6630
975	27	36 41.1	143 48.4	114	6194
976	27	36 40.5	144 03.4	114	5885 ± 75
977	27	36 41.1	144 26.5	114	6168 ± 90
978	28	36 53.2	145 22.3	115	5650
979	28	37 01.8	145 22.5	115	5518
980	29	37 35.9	145 27.2	115	5433
981	29	37 57.5	145 30.3	115	5253
982	29	38 04.2	145 49.6	115	5291 ±100
983	30	38 04.8	146 16.9	115	4889 ± 50
984	30	38 05.5	146 47.6	116	5286 ±100
985	30	38 08.2	147 03.3	116	5449 ± 40
986	30	38 16.4	147 12.4	116	5555
987	30	38 22.6	147 21.5	116	5555
988	30	38 25.5	147 27.2	116	5578
989	July 1	38 38.2	147 38.8	116	5690
990	1	38 53.1	147 50.9	116	5644
991	1	39 08.9	148 07.1	116	5600
992	1	39 21.0	148 27.5	116	5511
993	2	39 37.1	149 12.4	116	5578
994	2	39 53.4	149 33.8	117	5428
995	2	40 01.4	149 52.1	117	5602
996	2	40 07.7	150 21.1	117	5326
997	3	40 18.3	150 57.4	117	5326
998	3	40 26.8	151 19.7	117	5266

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude N	Longitude E	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
999	July 3	40 28.7	151 33.1	117	5738
1000	3	40 41.3	151 50.6	117	5408
1001	4	41 11.5	152 50.6	117	5307 ± 30
1002	4	41 20.5	153 11.7	118	5384
1003	4	41 30.7	153 42.9	118	5489
1004	4	41 42.4	154 08.1	118	5364
1005	5	41 55.8	154 28.3	118	5364
1006	5	42 26.3	155 22.7	118	5404 ± 35
1007	5	42 46.6	155 58.2	118	5384 ± 40
1008	5	42 59.1	156 29.0	118	5467 ± 50
1009	5	43 10.3	157 02.2	118	5467
1010	6	43 24.9	157 53.9	118	5531
1011	6	43 41.5	158 10.3	118	5531
1012	6	44 05.1	158 25.7	119	5549
1013	6	44 25.0	158 43.3	119	5360
1014	6	44 42.8	158 59.6	119	5443
1015	7	45 19.5	159 33.0	119	5182
1016	7	45 48.5	159 57.1	119	5421 ± 30
1017	7	46 18.3	161 08.0	119	5421 ± 65
1018	8	46 46.6	162 26.6	119	5615 ± 50
1019	8	46 54.4	162 52.1	119	5637
1020	8	46 59.0	163 27.3	120	5730
1021	8	47 00.3	164 10.4	120	5874
1022	8	47 01.3	164 46.3	120	6051 ± 50
1023	9	47 02.7	166 10.8	120	5777
1024	9	47 01.6	166 27.6	120	5874
1025	9	47 03.4	167 00.4	120	5898
1026	9	47 09.0	167 36.8	120	6129
1027	9	47 10.8	167 50.6	120	6438
1028	10	46 54.7	168 56.4	121	5506 ± 50
1029	10	46 44.3	169 23.2	121	3961
1030	10	46 41.7	169 34.4	121	3465 ± 25
1031	10	46 37.7	169 47.4	121	4365
1032	10	46 30.2	170 08.4	121	6210
1033	10	46 22.3	170 32.5	121	6210
1034	11	46 07.3	171 27.5	121	5684
1035	11	45 49.8	171 56.0	121	5777
1036	11	45 35.0	172 11.6	121	5639
1037	11	45 13.8	172 36.4	121	5639 ± 50
1038	12	45 06.9	172 50.4	122	4489
1039	12	45 14.6	172 55.6	122	5616
1040	12	45 25.6	173 07.6	122	5684
1041	12	45 34.5	173 18.1	122	5753
1042	12	45 47.2	173 33.8	122	5875 ± 50
1043	13	46 10.6	173 57.1	122	6077
1044	13	46 36.6	174 36.5	122	5662 ± 65
1045	14-1	47 47.0	177 25.8	122	5707 ±150
1046	14-1	48 06.1	178 02.9	122	5684 ± 50
1047	14-1	48 16.8	178 50.5	122	6012 ± 60
1048	14-1	48 26.4	179 37.6	122	5948 ±100
			W		
1049	14-2	49 01.2	177 23.2	123	5330 ±100
1050	14-2	49 12.9	176 42.6	123	4747 ± 30
1051	14-2	49 25.9	175 57.9	123	5183 ± 30
1052	14-2	49 37.8	175 20.6	123	5203
1053	14-2	49 51.7	174 36.9	123	5072
1054	15	50 22.2	173 03.5	123	5464 ± 30
1055	15	50 39.6	171 41.4	123	5755 ± 50
1056	15	50 45.4	171 00.3	123	5595
1057	16	50 54.6	169 48.5	123	5802
1058	16	51 06.6	168 15.6	123	5203
1059	16	51 22.5	167 29.6	123	5146
1060	16	51 34.3	166 27.0	124	5019
1061	16	51 44.2	165 30.2	124	4862
1062	16	51 54.4	164 26.6	124	4897 ± 30
1063	17	52 13.8	162 22.2	124	4780 ± 30
1064	17	52 28.8	160 58.5	124	4550
1065	17	52 33.0	159 54.4	124	4550
1066	17	52 34.2	158 45.1	124	4716 ± 25
1067	18	52 37.1	156 36.7	124	4550
1068	18	52 34.0	155 40.9	125	4520
1069	18	52 27.7	154 50.8	125	4536
1070	18	52 21.4	153 54.7	125	4565

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
1071	July 18	52 14.2	152 56.7	125	4407
1072	19	51 59.0	150 55.1	125	4536 ± 30
1073	19	51 45.0	149 51.8	125	4717
1074	19	51 27.9	149 04.7	125	4520 ± 30
1075	19	51 10.3	148 16.3	125	4450
1076	20	51 00.8	147 51.1	125	4353 ± 25
1077	20	50 36.8	146 53.5	125	4421 ± 30
1078	20	50 11.6	146 04.2	125	3897 ± 50
1079	20	49 51.6	145 28.3	126	4265 ± 25
1080	20	49 28.4	144 55.8	126	4189 ± 25
1081	20	49 00.1	144 12.7	126	4277
1082	21	48 08.9	143 04.2	126	4382 ± 30
1083	21	47 40.3	142 18.0	126	4424
1084	21	47 19.9	141 45.0	126	4438
1085	21	46 53.6	141 04.5	126	4356
1086	22	46 39.7	140 42.3	126	4356
1087	22	46 18.4	140 16.3	126	4356
1088	22	46 01.7	139 50.3	127	4318
1089	22	45 40.9	139 22.8	127	4305
1090	22	45 20.8	138 57.5	127	4292
1091	22	45 00.2	138 31.9	127	4242
1092	23	44 37.0	138 02.7	127	4178
1093	23	44 20.4	137 43.5	127	4154
1094	23	44 15.6	137 34.6	127	4141
1095	23	44 04.4	137 21.0	127	4130
1096	23	43 46.6	136 56.7	127	4035
1097	23	43 28.9	136 32.4	127	4024
1098	24	43 10.1	136 05.9	127	4024
1099	24	42 53.9	135 43.2	127	4012
1100	24	42 37.3	135 18.5	127	4012
1101	24	42 17.2	134 47.6	128	4050
1102	24	41 55.0	134 13.2	128	3579 ± 25
1103	24	41 54.7	134 12.7	128	3457
1104	24	41 54.0	134 11.7	128	3672 ± 20
1105	24	41 48.3	134 04.1	128	3893
1106	24	41 29.9	133 39.2	128	3719
1107	25	40 59.4	132 56.8	128	3738
1108	25	40 39.7	132 30.1	128	3970
1109	25	40 31.1	131 59.2	128	3851
1110	25	40 19.1	131 26.2	128	3482
1111	25	40 12.4	131 08.7	128	3662
1112	26	39 58.8	130 31.5	128	4557
1113	26	39 50.1	130 07.2	128	4484 ± 25
1114	26	39 35.8	129 31.7	128	4513
1115	26	39 27.6	129 00.1	129	4310 ± 25
1116	26	39 20.5	128 21.7	129	4183
1117	26	39 10.6	127 33.2	129	4363 ± 40
1118	27	39 00.7	126 44.2	129	4297 ± 30
1119	27	38 51.6	126 11.3	129	4171 ± 40
1120	27	38 40.8	125 16.2	129	3511 ± 25
1121	27	38 32.7	124 46.8	129	3782 ± 20
1122	28	38 16.9	123 37.7	129	1016 ± 7
1123	28	38 15.3	123 30.0	129	511 ± 5
1124	28	38 14.2	123 27.3	129	344 ± 6
1125	28	38 12.7	123 24.7	129	319 ± 5
1126	28	38 11.0	123 22.0	129	246 ± 5
1127	28	38 09.1	123 19.2	129	164 ± 5
1128	28	38 07.3	123 16.3	129	132 ± 5
1129	Sep. 3	37 37.5	122 51.7	130	88 ± 2
1130	3	37 26.0	123 05.6	130	559
1131	4	37 03.7	123 43.1	130	3188
1132	5	35 20.0	125 08.3	131	4487 ± 30
1133	5	34 58.6	125 30.3	131	4574
1134	5	34 45.0	125 40.5	131	4590
1135	5	34 29.4	125 52.4	131	4726
1136	6	33 50.3	126 21.3	131	4432
1137	6	33 17.9	126 56.0	131	4432
1138	6	33 01.3	127 15.9	131	4502
1139	7	32 47.1	127 30.6	131	4404 ± 30
1140	7	32 35.9	127 39.6	132	4077
1141	7	32 25.6	127 50.5	132	1373 ± 10
1142	7	32 25.1	127 51.4	132	1766 ± 10

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
1143	Sep. 7	32 24.8	127 52.0	132	2126
1144	7	32 22.0	127 55.6	132	3735
1145	7	32 16.7	128 01.3	132	4260
1146	7	32 10.7	128 09.3	132	4161
1147	7	32 08.8	128 12.2	132	4392
1148	8	31 59.2	128 26.7	132	4273
1149	8	31 48.8	128 36.9	132	4248 ± 25
1150	8	31 40.0	128 49.1	132	4312
1151	8	31 38.3	128 48.4	132	4299
1152	8	31 25.9	129 06.4	132	4392 ± 30
1153	8	31 12.8	129 30.4	132	4432 ± 45
1154	8	31 00.3	129 51.4	132	4620
1155	9	30 47.7	130 12.6	132	4488
1156	9	30 37.4	130 29.8	132	4636
1157	9	30 25.6	130 50.6	133	4731
1158	9	30 14.6	131 08.9	133	4327
1159	9	30 00.5	131 29.3	133	4654
1160	9	29 46.9	131 49.3	133	4151
1161	10	29 31.3	132 12.3	133	4289
1162	10	29 23.6	132 23.7	133	4381 ± 25
1163	10	28 57.8	133 07.2	133	4176
1164	10	28 45.9	133 25.5	133	4684
1165	11	28 33.1	133 44.7	133	4550
1166	11	28 21.4	134 01.8	134	4508
1167	11	28 13.6	134 16.6	134	4595
1168	11	28 07.6	134 29.3	134	4252
1169	11	28 02.0	134 42.4	134	4225
1170	11	27 51.8	135 01.2	134	4277
1171	12	27 48.3	135 11.1	134	4522
1172	12	27 45.5	135 19.0	134	4508
1173	12	27 32.7	136 05.2	134	4610 ± 65
1174	13	27 17.1	136 54.1	134	4656 ± 45
1175	13	27 11.2	137 13.0	134	4701 ± 50
1176	13	26 59.8	137 42.3	135	4780 ± 50
1177	13	26 51.4	138 09.4	135	4828 ± 50
1178	13	26 43.8	138 26.6	135	4731
1179	14	26 37.9	139 06.0	135	4655 ± 25
1180	14	26 34.4	139 51.1	135	4685
1181	15	26 37.3	140 08.1	135	4763 ± 80
1182	15	26 27.3	140 35.7	136	4748
1183	15	26 24.7	140 49.2	136	4671
1184	15	26 25.8	141 02.0	136	4685
1185	16	26 25.1	141 24.8	136	4829
1186	16	26 21.9	141 32.5	136	4671
1187	16	26 14.1	141 55.3	136	4625
1188	16	26 09.9	142 12.3	136	4625
1189	17	25 18.0	143 17.4	136	4812
1190	17	25 07.4	143 36.6	136	4845
1191	17	24 58.5	143 49.1	137	5001
1192	17	24 46.3	144 08.0	137	5001
1193	17	24 35.2	144 28.7	137	4881
1194	18	24 19.9	144 56.4	137	5091 ± 40
1195	18	24 01.6	145 29.9	137	5147
1196	18	23 56.4	145 53.3	137	5147
1197	18	23 43.2	146 21.7	137	5494
1198	18	23 35.9	146 59.0	137	5894
1199	19	23 31.2	147 28.9	137	5203
1200	19	23 27.7	148 02.4	137	5221
1201	19	23 22.0	148 36.8	138	5224
1202	19	23 17.0	149 04.8	138	5263
1203	19	23 11.8	149 33.3	138	5383
1204	20	23 05.2	150 10.1	138	5402
1205	20	23 01.3	150 30.9	138	5485
1206	20	22 55.0	151 06.4	138	5455
1207	20	22 47.0	151 41.9	138	5282
1208	20	22 40.8	152 02.6	138	5362
1209	20	22 32.3	152 25.9	138	5057
1210	21	22 26.7	152 52.3	138	5057
1211	21	22 20.5	153 14.2	138	4917
1212	21	22 17.0	153 33.3	139	4734
1213	21	22 14.3	153 53.1	139	4704
1214	21	22 11.6	154 12.4	139	4582
1215	21	22 04.6	154 38.1	139	4467

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
1216	Sep. 22	21 57.7	155 00.7	139	4553
1217	22	21 50.1	155 24.0	139	4897
1218	22	21 47.5	155 30.8	139	5073
1219	22	21 41.7	155 50.0	139	5360
1220	22	21 38.9	156 04.4	139	5538
1221	22	21 34.7	156 20.4	139	5483
1222	22	21 32.1	156 34.7	139	5128
1223	23	21 27.5	156 57.0	139	2929
1224	23	21 23.2	157 17.7	139	671
1225	Oct. 2	21 31.9	158 22.5	140	1399 ± 10
1226	2	22 16.4	158 46.8	140	4434 ± 25
1227	3	23 19.4	159 21.6	140	4785
1228	3	23 50.7	159 40.6	140	4674
1229	3	24 23.4	159 50.9	140	4706
1230	3	24 49.4	159 59.9	140	4661 ± 25
1231	4	25 37.9	160 16.7	140	2548
1232	4	25 46.0	160 19.3	140	4360
1233	4	25 47.7	160 19.7	140	4557
1234	4	26 25.9	160 31.8	141	4767 ± 25
1235	4	26 51.2	160 38.4	141	5002 ± 40
1236	4	27 26.0	160 45.8	141	4439
1237	4	27 56.9	160 53.1	141	5166
1238	5	28 17.0	160 58.7	141	4932 ± 25
1239	5	28 55.8	161 08.0	141	5637
1240	5	29 29.0	161 15.2	141	5549
1241	5	30 04.3	161 21.9	141	5705
1242	5	30 32.6	161 24.5	141	4242
1243	6	30 54.5	161 19.3	142	5591 ± 35
1244	6	31 15.9	161 10.6	142	5591
1245	6	31 38.3	161 01.6	142	5658
1246	6	32 00.6	160 55.8	142	5703
1247	6	32 17.3	160 49.9	142	5772
1248	6	32 28.6	160 45.7	142	5845
1249	7	32 40.5	160 42.3	142	5703
1250	7	32 59.1	160 37.1	142	6148
1251	7	33 14.3	160 29.5	142	5726 ±100
1252	7	33 28.0	160 26.3	142	5966 ± 60
1253	8	34 05.6	160 17.9	142	5893 ± 50
1254	8	34 15.4	159 59.7	142	5893
1255	8	34 18.1	159 48.7	142	5845
1256	8	34 18.1	159 23.9	142	5942
1257	8	34 15.8	158 48.3	143	5889 ± 30
1258	9	34 06.0	157 18.2	143	5841 ± 30
1259	9	33 59.0	156 26.5	143	5770
1260	9	33 51.8	155 44.4	143	5700
1261	9	33 48.5	155 26.0	143	5632
1262	10	33 45.1	155 09.6	143	5522
1263	10	33 41.0	154 52.2	143	5544
1264	10	33 36.1	154 33.9	143	5588 ± 75
1265	10	33 35.0	154 09.1	144	5545 ± 50
1266	10	33 35.1	153 44.0	144	5567 ± 50
1267	10	33 35.4	153 07.3	144	5701
1268	11	33 35.6	152 38.2	144	5567 ± 30
1269	11	33 37.5	151 59.1	144	5523
1270	11	33 35.9	151 09.5	144	5523
1271	11	33 32.3	150 28.3	144	5418 ± 30
1272	11	33 28.8	149 48.6	144	5567
1273	12	33 25.3	149 06.9	144	5567
1274	12	33 22.6	148 23.7	145	5565 ± 40
1275	12	33 16.8	147 48.4	145	5610
1276	12	33 18.7	147 24.8	145	5458
1277	12	33 20.3	147 03.9	145	5458 ± 50
1278	12	33 22.7	146 34.4	145	5565 ± 30
1279	13	33 27.3	145 36.0	145	5068 ± 35
1280	13	33 27.3	145 30.1	145	5522
1281	13	33 27.0	145 13.8	145	5458
1282	13	33 27.5	145 00.9	145	4406
1283	13	33 28.6	144 40.0	145	5295
1284	14	33 32.0	143 45.6	145	5355
1285	14	33 20.0	142 45.9	146	5298
1286	14	32 57.6	142 19.5	146	5163
1287	14	32 34.7	141 47.9	146	5358

Table 4. Sonic depths--number and geographic position of sounding--Continued

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
1288	Oct. 15	32 08.7	141 12.2	146	5071
1289	15	31 52.2	140 52.7	146	4914 ± 25
1290	15	31 27.8	140 35.5	146	4686
1291	15	31 10.3	140 23.4	146	4537
1292	15	30 41.7	140 08.3	146	4829
1293	16	30 07.5	139 50.4	146	4797 ± 25
1294	16	29 42.7	139 37.3	146	4748
1295	16	29 11.0	139 22.5	147	4763
1296	16	28 40.0	139 07.7	147	4747
1297	16	28 26.8	139 01.8	147	4780
1298	16	28 08.8	138 47.7	147	4797 ± 50
1299	17	27 46.0	138 29.8	147	4879 ± 70
1300	17	27 26.5	138 14.3	147	4717
1301	17	27 04.1	137 47.7	147	4879 ± 50
1302	17	26 54.5	137 37.3	147	4879 ± 75
1303	17	26 38.4	137 21.0	147	4913 ± 75
1304	18	26 09.4	136 54.0	148	4733 ± 35
1305	18	26 00.1	137 06.8	148	4686
1306	18	25 54.9	137 14.2	148	4718
1307	18	25 35.3	137 23.7	148	4733
1308	19	25 08.5	137 33.5	148	4764
1309	19	24 58.5	137 41.4	148	4343
1310	19	24 56.6	137 43.2	148	4813
1311	19	24 50.5	137 41.3	148	4671
1312	19	24 40.5	137 39.4	148	4749
1313	19	24 19.1	137 39.4	148	4879
1314	20	23 52.2	137 53.4	148	4595
1315	20	23 36.5	138 03.3	148	5053
1316	20	23 05.0	138 18.0	149	4914
1317	20	22 50.2	138 23.8	149	5054
1318	20	22 29.0	138 29.7	149	5165
1319	20	22 07.1	138 36.3	149	4881
1320	21	21 39.1	138 40.3	149	5165
1321	21	21 21.2	138 37.0	149	5183
1322	21	20 53.3	138 33.6	149	5221
1323	21	20 23.0	138 23.2	149	5109
1324	21	19 52.0	138 20.8	149	5165
1325	22	19 18.7	138 20.4	149	5221
1326	22	18 53.8	138 14.0	149	5165
1327	22	18 21.0	138 03.1	150	5259
1328	22	17 58.0	137 49.0	150	5035
1329	22	17 10.1	137 24.4	150	5239
1330	23	16 39.7	137 12.6	150	5239
1331	23	16 24.6	137 07.0	150	5612
1332	23	16 16.4	137 05.5	150	4130
1333	23	16 02.6	137 00.2	150	4880
1334	23	15 50.3	136 54.7	150	4880
1335	23	15 23.4	136 40.8	150	4983 ± 25
1336	23	14 52.8	136 24.8	150	5035 ± 30
1337	24	14 20.2	136 16.1	151	4480
1338	24	14 13.5	136 12.7	151	4702
1339	24	14 00.1	136 15.5	151	4584
1340	24	13 23.6	136 44.0	151	4702
1341	24	13 13.0	136 53.0	151	4813 ± 75
1342	24	13 09.6	137 05.8	151	4813 ± 50
1343	25	12 57.4	137 19.4	151	5090 ±100
1344	25	12 41.2	137 32.6	151	4880
1345	25	12 29.2	137 38.5	151	5019 ± 50
1346	25	12 17.6	137 48.3	151	4983 ± 25
1347	25	12 02.0	138 01.6	151	5019
1348	26	11 29.7	138 29.1	151	4914 ± 50
1349	26	11 20.7	138 38.4	152	4914
1350	26	11 07.9	138 50.2	152	4846 ± 50
1351	26	10 56.5	139 02.9	152	4813 ± 30
1352	26	10 40.1	139 15.8	152	4718 ± 50
1353	27	10 20.1	139 31.8	152	4982 ± 50
1354	27	10 04.5	139 44.3	152	4830
1355	27	9 53.2	139 53.5	152	5035 ± 50
1356	27	9 35.4	140 09.2	152	4965 ± 50
1357	27	9 20.1	140 17.8	152	5107 ± 60
1358	28	8 47.2	140 35.9	153	5093 ± 35
1359	28	8 38.3	140 42.2	153	5148
1360	28	8 30.8	140 46.0	153	5167

Sounding no.	Date	Latitude N	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
1361	Oct. 28	8 20.8	140 54.6	153	5074
1362	28	8 09.3	141 05.2	153	5301
1363	29	7 58.7	141 14.7	153	4833
1364	29	7 56.5	141 16.2	153	4916 ± 25
1365	29	7 47.3	141 24.2	153	5038
1366	29	7 37.4	141 32.8	153	5111
1367	29	7 31.2	141 44.0	153	5167
1368	30	7 14.2	142 13.3	153	5021
1369	30	7 04.7	142 27.6	154	5075
1370	30	6 54.9	142 48.2	154	5021
1371	30	6 50.5	143 14.7	154	5004
1372	30	6 43.7	143 23.5	154	4722
1373	31	6 43.9	143 20.9	154	4917 ± 25
1374	31	6 41.9	143 22.7	154	5149 ± 50
1375	31	6 37.0	143 27.3	154	5094
1376	31	6 22.6	143 41.6	154	5112 ± 75
1377	31	6 10.4	143 54.0	154	5112
1378	Nov. 1	5 57.9	144 07.8	154	5112 ± 30
1379	1	5 42.3	144 24.4	154	5039
1380	1	5 45.0	144 39.7	154	4987
1381	1	5 42.6	144 50.5	154	5004
1382	1	5 31.1	145 13.6	155	5022
1383	1	5 14.5	145 38.6	155	4850
1384	2	4 54.7	146 09.8	155	4968 ± 50
1385	2	4 50.0	146 36.9	155	4987
1386	2	4 53.6	146 57.9	155	5040 ± 30
1387	2	4 44.9	147 18.9	155	5186
1388	2	4 35.3	147 44.6	155	4900
1389	3	4 30.0	148 06.4	155	4968 ± 25
1390	3	4 24.5	148 34.1	156	4919 ± 25
1391	3	4 19.8	149 11.4	156	4662 ± 25
1392	3	4 14.1	149 22.9	156	4851 ± 25
1393	3	4 02.6	149 24.3	156	4885 ± 50
1394	3	3 45.7	149 27.5	156	4885 ± 25
1395	4	3 25.8	149 34.6	156	5058 ± 35
1396	4	2 59.7	149 42.9	156	5058
1397	4	2 54.0	149 57.9	156	4430
1398	4	2 36.0	150 14.6	156	4646
1399	4	2 10.1	150 39.2	156	4616 ± 25
1400	5	1 44.3	150 57.2	156	4183
1401	5	1 40.8	150 59.4	156	4170 ± 25
1402	5	1 36.7	151 01.5	156	4146
1403	5	1 22.5	151 10.5	157	3995
1404	5	1 15.2	151 14.7	157	4030
1405	5	1 06.3	151 20.1	157	4296
1406	5	0 51.4	151 26.4	157	4099
1407	5	0 34.8	151 33.4	157	4134
1408	5	0 18.4	151 43.7	157	3012
		S			
1409	5	0 03.3	151 54.0	157	4296 ± 25
1410	5	0 24.1	152 00.5	157	4442
1411	5	0 42.8	152 05.1	157	4723
1412	6	0 56.0	152 08.5	157	4723 ± 25
1413	6	1 12.8	152 12.8	157	4851 ± 25
1414	6	1 30.4	152 17.3	157	4803
1415	6	1 44.3	152 20.6	157	3985
1416	6	2 16.2	152 26.6	157	4616 ± 25
1417	6	2 50.0	152 33.8	157	4675
1418	6	3 26.8	152 43.5	157	4918 ± 25
1419	7	3 53.4	152 50.6	157	4969 ± 35
1420	7	4 27.1	153 00.3	158	5077
1421	7	4 47.1	153 19.2	158	4008
1422	7	5 09.8	153 41.0	158	4819
1423	7	5 28.3	153 58.1	158	5265
1424	7	5 49.0	154 17.5	158	5114
1425	8	6 07.1	154 34.7	158	4919
1426	8	6 27.8	154 54.3	158	5096
1427	8	6 33.7	154 58.6	158	4065
1428	8	6 51.7	155 20.0	158	5114
1429	8	7 04.0	155 33.7	158	5059
1430	8	7 22.6	155 58.1	158	5096
1431	9	7 34.8	156 14.4	158	5041

Table 4. Sonic depths--number and geographic position of sounding--Concluded

Sounding no.	Date	Latitude S	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
1432	Nov. 9	7 49.0	156 31.0	158	5132
1433	9	8 01.4	156 49.5	158	5305
1434	9	8 16.1	157 09.0	159	5386
1435	9	8 22.4	157 18.7	159	5386
1436	9	8 29.7	157 28.0	159	5325
1437	9	8 34.6	157 35.7	159	5133
1438	9	8 42.2	157 42.7	159	4617
1439	10	8 44.2	157 44.3	159	4336
1440	10	8 45.2	157 45.0	159	4148
1441	10	8 48.3	157 47.3	159	3746
1442	10	8 51.3	157 51.0	159	1865 ± 10
1443	10	8 52.9	157 53.9	159	1999
1444	10	8 55.3	158 01.2	159	984 ± 5
1445	10	8 56.5	158 03.6	159	426 ± 5
1446	10	8 59.7	158 03.8	159	381 ± 5
1447	10	8 59.7	158 03.8	159	96 ± 5
1448	10	9 01.3	158 07.4	159	1833 ± 30
1449	10	9 04.2	158 13.9	159	3909
1450	10	9 06.4	158 18.9	159	4431
1451	10	9 08.9	158 24.5	159	4954
1452	11	9 15.1	158 38.3	159	5365
1453	11	9 22.6	158 55.2	159	5405
1454	11	9 28.0	159 15.6	159	5115
1455	11	9 32.9	159 29.6	159	5899
1456	11	9 38.5	159 44.7	159	4937
1457	12	9 47.0	160 06.8	159	4065
1458	12	9 57.3	160 32.1	160	3146
1459	12	9 58.3	160 34.6	160	2865 ± 30
1460	12	10 09.1	160 46.1	160	4286
1461	12	10 17.5	160 52.9	160	3239
1462	12	10 19.1	160 57.7	160	2520
1463	12	10 19.7	161 00.1	160	1186
1464	12	10 19.6	161 01.6	160	738 ± 5

Sounding no.	Date	Latitude S	Longitude W	Station no.	Depth in meters
	1929	° ′	° ′		
		Pacific Ocean			
1465	Nov.12	10 24.9	161 05.2	160	1199
1466	12	10 28.1	161 10.9	160	2825
1467	12	10 35.5	161 23.3	160	2984
1468	13	10 41.2	161 32.4	160	2877
1469	13	10 50.5	161 47.9	160	2639 ± 15
1470	13	10 53.3	161 52.8	160	2602 ± 15
1471	13	11 06.8	162 17.3	160	2583 ± 15
1472	13	11 18.1	162 40.3	160	2621 ± 15
1473	13	11 23.0	162 49.7	160	2719 ± 20
1474	14	11 26.9	162 56.7	160	2719 ± 20
1475	14	11 30.7	163 02.4	160	2825 ± 25
1476	14	11 33.9	163 13.3	160	3329 ± 40
1477	14	11 39.3	163 37.2	161	3603 ± 40
1478	14	11 43.7	163 50.6	161	3622 ± 40
1479	14	11 50.7	164 13.4	161	3515 ± 30
1480	15	11 55.7	164 29.0	161	3736 ± 40
1481	15	12 04.2	164 57.4	161	4458
1482	15	12 05.4	165 07.7	161	4485 ± 30
1483	15	12 14.1	165 30.9	161	5455 ± 28
1484	16	12 38.9	166 35.4	161	5208 ± 50
1485	16	12 48.3	166 53.8	162	5509
1486	16	13 01.0	167 19.9	162	5377 ± 30
1487	16	13 10.2	167 37.3	162	5303 ± 50
1488	16	13 19.9	167 55.2	162	5208 ± 50
1489	17	13 25.6	168 05.7	162	5095 ± 55
1490	17	13 36.0	168 22.8	162	5059
1491	17	13 41.2	168 37.9	162	5208 ± 30
1492	17	13 46.5	168 56.2	162	5023 ± 50
1493	17	13 52.2	169 15.1	162	5446 ± 60
1494	18	14 05.3	169 59.4	162	2462 ± 15
1495	18	14 08.9	170 13.4	162	2409 ± 25
1496	18	14 13.7	170 26.8	162	1568 ± 15

[a] Sounding velocity of 1508 meters per second assumed. [b] Beginning of oceanographic station 3. [c] End of oceanographic station 3. [d] Doubtful. [e] Probably shallow. [f] Sounding continuously for 5 minutes. Course southwest true at 7 1/2 knots. [g] Sounding continuously for 11 minutes. Course S × W 1/2 W true at 5.7 knots. [h] Synchronism poor.

Table 5—Sounding velocity in meters per second for *Carnegie* deep sea stations, 1928-1929

[The values appearing below the heavy line are based on extrapolated temperatures or salinities]

Depth in meters	1 38°14'N 67 34 W	2 39°06'N 45 41 W	3 44°00'N 36 10 W	4 44°39'N 33 06 W	5 43°15'N 31 32'W	6 50°22'N 13 31 W	7 63°20'N 9 25 W	8 63 30'N 14 41 W	9 62°45'N 25 52 W	10 59°19'N 34 15 W	11 58°12'N 35 51 W	12 51°40'N 49 32 W	13 46°06'N 48 01 W	14 42°10'N 47 19 W	15 38°39'N 48 48 W	16 36°47'N 46 31 W	17 33°42'N 42 21 W	18 29°47'N 40 36 W	19 24°00'N 39 36 W	20 19°13'N 38 28 W
0	1530.5	1521.6	1506.6	1503.5	1505.0	1496.0	1482.9	1488.1	1490.7	1490.0	1489.0	1479.3	1488.6	1522.2	1532.6	1535.1	1536.3	1538.4	1537.6	1535.8
25	1530.9	1521.9	1506.6	1503.9	1505.1	1496.1	1483.1	1487.3	1490.6	1489.4	1488.0	1475.8	1467.7	1522.2	1530.6	1535.3	1534.1	1537.4	1537.9	1535.8
50	1531.1	1522.2	1506.3	1503.9	1505.1	1495.7	1482.6	1486.2	1488.3	1488.9	1485.1	1471.9	1454.8	1517.9	1527.7	1534.7	1531.6	1534.7	1537.3	1535.8
75	1530.6	1522.4	1505.7	1503.6	1504.5	1495.2	1482.2	1485.5	1485.7	1487.1	1482.0	1469.0	1449.0	1513.7	1525.0	1532.9	1529.3	1531.8	1535.7	1535.3
100	1529.5	1522.2	1504.8	1503.2	1503.9	1495.0	1482.0	1484.9	1484.2	1484.8	1480.2	1467.4	1446.5	1511.3	1523.2	1530.8	1527.4	1529.8	1534.1	1534.0
200	1524.7	1521.0	1503.4	1501.5	1503.1	1494.4	1481.9	1484.2	1482.0	1479.7	1477.0	1465.4	1445.9	1507.0	1520.6	1525.1	1523.1	1525.5	1530.2	1529.3
300	1521.0	1520.5	1503.1	1500.3	1502.8	1494.2	1480.3	1484.2	1481.8	1477.7	1475.7	1465.2		1504.7	1520.0	1522.1	1521.3	1522.9	1526.7	1524.7
400	1518.4	1519.9	1502.8	1499.9	1502.8	1494.5	1476.8	1484.7	1481.9	1476.7	1475.1	1465.5		1501.8	1520.2	1519.9	1520.0	1521.0	1523.7	1520.9
500	1516.3	1519.0	1502.1	1499.3	1502.9	1495.0	1472.8	1485.2	1482.0	1476.1	1474.8	1466.1		1498.7	1520.3	1517.7	1518.7	1519.3	1521.2	1517.9
1000		1515.7	1496.7	1495.2	1500.8	1496.7		1485.4	1482.3	1476.4	1475.5	1469.7		1490.3	1516.4	1507.7	1510.6	1511.8	1511.2	1507.0
1500		1510.0	1493.6	1492.6	1498.0	1497.0		1485.2	1483.2	1478.7	1478.3	1473.8		1488.1	1510.5	1501.9	1505.0	1506.7	1505.2	1501.5
2000		1506.4	1493.5	1492.6	1497.0	1496.5		1486.8	1485.2	1481.9	1481.6	1477.8		1489.0	1506.8	1499.7	1502.6	1504.5	1502.8	1499.9
2500		1505.5	1494.8	1494.2	1497.8	1497.3				1485.5	1485.4	1481.8		1491.2	1505.8	1499.9	1502.3	1504.1	1502.5	1500.2
3000		1506.1	1497.1	1496.5	1499.6	1499.2				1489.3	1489.2	1485.8		1494.1	1506.4	1501.3	1503.4	1505.0	1503.5	1501.6
3500		1507.7	1499.9	1499.4	1502.1	1501.6				1493.2	1493.1	1490.0		1497.3	1508.0	1503.5	1505.1	1506.7	1505.2	1503.6
4000		1509.9	1503.1	1502.8	1505.0	1504.7					1497.1			1500.6	1510.0	1506.1	1507.6	1508.9	1507.7	1506.3
4500		1512.5	1506.6	1506.1	1508.1	1507.9								1504.1	1512.6	1509.2	1510.5	1511.6	1510.6	1509.2
5000		1515.3	1510.0	1509.7	1511.5	1511.3									1515.5	1512.4	1513.5	1514.7	1513.7	1512.4
5500		1518.4	1513.8	1513.5	1515.1										1518.6	1515.8			1517.0	1515.7
6000															1521.9				1520.5	1519.2
6500																				
7000																				
7500																				

Depth in meters	21 15°50'N 37 56 W	22 13°25'N 38 00 W	23 10°50'N 37 24 W	24 8°15'N 36 10 W	25 11°02'N 37 06 W	26 11°33'N 40 43 W	27 11°20'N 44 12 W	28 13°10'N 49 36 W	29 13°16'N 52 13 W	30 12°54'N 56 15 W	31 14°46'N 63 26 W	32 15°18'N 68 11 W	33 13°37'N 76 22 W	34 11°18'N 78 34 W	35 6°32'N 80 04 W	36 2°54'N 80 02 W	37 5°59'N 82 56 W	38 3°46'N 81 37 W	39 0°52'N 81 14 W	40 1°32'S 82 16 W
0	1536.7	1536.7	1537.9	1537.1	1538.0	1538.9	1538.9	1539.0	1538.9	1539.9	1539.3	1539.6	1540.5	1540.8	1531.9	1531.8	1533.2	1533.1	1529.2	1523.2
25	1536.3	1536.6	1537.9	1537.6	1537.6	1539.3	1539.0	1539.2	1539.0	1539.9	1539.8	1539.8	1540.5	1541.1	1530.6	1532.4	1530.9	1533.2	1529.5	1517.6
50	1535.3	1535.6	1534.2	1535.6	1534.2	1537.4	1538.4	1539.0	1539.0	1539.9	1539.9	1539.6	1540.6	1539.3	1525.1	1528.0	1527.3	1530.6	1524.2	1513.2
75	1533.5	1533.7	1529.3	1531.2	1529.3	1533.8	1536.1	1537.9	1538.4	1539.5	1539.5	1538.2	1539.9	1537.3	1519.3	1521.9	1522.6	1525.8	1518.0	1510.2
100	1531.8	1530.3	1525.4	1526.6	1524.4	1528.7	1532.4	1536.4	1537.1	1538.4	1538.0	1536.1	1537.9	1535.0	1515.5	1517.4	1518.7	1521.6	1514.2	1508.3
200	1523.2	1518.3	1516.1	1512.6	1510.9	1513.8	1518.9	1526.8	1529.2	1528.7	1529.8	1528.3	1530.2	1526.0	1509.2	1510.0	1510.9	1513.2	1508.0	1505.1
300	1515.7	1510.9	1509.6	1504.8	1503.6	1505.8	1510.6	1518.2	1521.0	1519.5	1521.5	1521.8	1524.1	1519.2	1506.0	1506.6	1506.3	1509.0	1505.5	1503.2
400	1510.6	1506.6	1504.5	1500.3	1499.3	1501.0	1505.7	1512.1	1514.4	1512.9	1514.8	1516.1	1519.0	1513.5	1502.6	1503.6	1502.8	1505.4	1503.1	1501.2
500	1506.8	1503.5	1501.3	1497.4	1496.5	1498.0	1502.3	1507.7	1509.4	1508.4	1509.7	1511.3	1514.4	1508.9	1499.3	1501.2	1500.0	1502.2	1500.3	1499.0
1000	1497.8	1496.1	1493.9	1490.9	1490.6	1491.5	1494.4	1497.4	1497.8	1497.8	1498.1	1499.3	1501.6	1497.8	1491.8	1494.1	1493.2	1494.2	1492.9	1492.6
1500	1495.0	1493.8	1492.0	1490.0	1489.9	1490.3	1492.3	1494.7	1495.0	1494.8	1494.7	1495.4	1497.1	1494.5	1489.4	1491.2	1490.5	1491.8	1490.3	1490.0
2000	1494.8	1493.8	1492.6	1491.0	1490.9	1491.2	1492.8	1494.7	1495.0	1494.8	1494.8	1495.4	1496.7	1494.7	1489.4	1490.7	1490.2	1491.5	1489.9	1489.7
2500	1496.0	1495.2	1494.2	1492.9	1492.9	1493.1	1494.2	1495.8	1496.0	1496.0	1496.5	1497.1	1498.1	1496.5	1490.7	1491.8	1491.3	1492.5	1491.0	1490.7
3000	1498.0	1497.4	1496.5	1495.4	1495.5	1495.5	1496.4	1497.8	1498.0	1498.1	1499.3	1499.7	1500.6	1499.3	1492.9	1493.9	1493.5	1494.4	1492.9	1492.8
3500	1500.5	1500.0	1499.3	1498.4	1498.4	1498.4	1499.3	1500.5	1500.6	1500.6	1502.5	1502.9	1503.6	1502.5	1495.8	1496.7	1496.3	1497.1	1495.7	1495.5
4000	1503.5	1503.1	1502.3	1501.6	1501.6	1501.6	1502.5	1503.4	1503.5	1503.6	1506.0	1506.3	1507.0	1506.0	1499.2	1499.9	1499.6	1500.3	1498.7	1498.6
4500	1506.7	1506.4	1505.8	1505.1	1505.1	1505.1	1505.8	1506.7	1506.7	1506.8	1509.7	1510.0	1510.6		1502.8	1503.5	1503.2	1503.8	1502.1	1501.9
5000	1510.2	1509.7	1509.3	1508.6	1508.7	1508.7	1509.3	1510.0	1510.2	1510.2	1513.7	1513.8	1514.4		1506.6	1507.1	1507.0		1505.7	
5500	1513.7	1513.4	1512.9	1512.4	1512.4	1512.4		1513.7	1513.7	1513.8		1517.9								
6000	1517.3	1517.0	1516.6						1517.4											
6500		1520.8																		
7000																				
7500																				

Table 5—Sounding velocity in meters per second for Carnegie deep sea stations, 1928-1929—Continued

[The values appearing below the heavy line are based on extrapolated temperatures or salinities]

Depth in meters	Station number, latitude, and longitude																			
	41 1°37'S 86 58 W	42 1°32'S 93 10 W	43 2°30'S 95 43 W	44 3°15'S 99 48 W	45 4°35'S 105 03 W	46 9°06'S 108 20 W	47 14°07'S 111 50 W	48 19°06'S 114 07 W	49 23°16'S 114 45 W	50 26°27'S 115 21 W	51 29°06'S 114 48 W	52 31°28'S 112 51 W	53 29°06'S 108 44 W	54 29°17'S 108 54 W	55 32°03'S 110 55 W	56 31°49'S 109 04 W	57 33°59'S 106 43 W	58 36°51'S 104 05 W	59 39°51'S 101 04 W	60 40°24'S 97 33 W
0	1519.0	1514.7	1517.3	1520.3	1525.5	1527.7	1529.9	1529.8	1528.9	1528.2	1526.8	1525.7	1526.3	1528.4	1519.6	1520.8	1515.1	1508.9	1506.8	1502.5
25	1516.6	1514.7	1517.6	1520.5	1525.7	1527.9	1530.0	1530.0	1528.9	1527.1	1525.0	1523.7	1526.0	1525.7	1519.9	1520.9	1515.1	1507.7	1505.7	1501.5
50	1512.6	1513.8	1515.8	1520.6	1526.0	1528.0	1530.2	1530.2	1528.6	1526.6	1523.7	1522.5	1525.4	1523.4	1519.0	1519.6	1512.6	1506.3	1504.1	1500.5
75	1509.7	1511.8	1513.1	1517.9	1525.8	1528.0	1530.2	1530.2	1528.0	1526.0	1522.9	1521.5	1524.7	1521.9	1517.6	1517.9	1510.0	1504.4	1502.1	1498.7
100	1508.3	1509.6	1510.5	1514.1	1524.5	1528.0	1530.0	1530.0	1527.4	1525.3	1522.5	1520.5	1524.0	1520.8	1516.1	1516.4	1508.3	1502.5	1500.2	1496.7
200	1505.8	1505.1	1505.1	1507.4	1515.8	1521.6	1528.0	1528.4	1525.5	1523.1	1520.2	1515.4	1520.5	1517.4	1511.9	1511.2	1503.5	1497.3	1494.1	1491.2
300	1504.4	1503.2	1503.1	1504.4	1509.6	1513.9	1522.4	1524.7	1522.1	1519.5	1516.7	1510.5	1516.4	1513.4	1507.6	1506.1	1499.3	1493.2	1489.9	1487.4
400	1502.5	1501.6	1501.3	1501.8	1505.8	1508.6	1515.4	1518.4	1516.7	1514.4	1512.1	1505.5	1511.5	1508.6	1502.9	1501.3	1495.5	1490.3	1487.4	1485.1
500	1500.0	1499.6	1499.2	1499.2	1502.8	1504.8	1509.9	1512.2	1511.3	1509.3	1507.3	1501.3	1506.6	1503.9	1499.0	1497.4	1492.8	1488.3	1486.0	1483.6
1000	1492.9	1492.8	1492.3	1493.0	1493.9	1495.2	1496.7	1497.6	1497.0	1496.1	1495.1	1491.6	1494.5	1492.9	1490.5	1489.4	1487.1	1484.5	1483.4	1481.6
1500	1490.3	1490.2	1489.7	1489.6	1490.5	1491.6	1492.3	1492.9	1492.0	1491.6	1490.9	1488.7	1490.6	1489.6	1488.0	1487.1	1485.8	1483.9	1483.2	1481.9
2000	1490.0	1489.7	1489.6	1489.4	1490.0	1490.7	1491.3	1491.6	1490.5	1490.5	1490.0	1488.4	1489.7	1489.0	1487.8	1487.3	1486.4	1484.9	1484.5	1483.5
2500	1491.0	1490.9	1490.7	1490.6	1491.0	1491.6	1492.0	1492.3	1491.6	1491.3	1490.9	1489.7	1490.7	1490.2	1489.2	1488.7	1488.4	1487.0	1486.5	1485.8
3000	1493.1	1492.9	1492.8	1492.6	1493.1	1493.6	1493.9	1494.1	1493.6	1493.4	1493.1	1491.9	1492.8	1492.3	1491.5	1491.0	1490.6	1489.7	1489.4	1488.7
3500	1495.7	1495.5	1495.5	1495.4	1495.7	1496.3	1496.5	1496.7	1496.3	1496.1	1495.7	1494.8	1495.5	1495.1	1494.4	1494.1	1493.6	1492.8	1492.5	1491.9
4000	1498.7	1498.6	1498.6	1498.4	1498.7	1499.4		1499.7	1499.3	1499.2	1498.9	1498.0		1498.3	1497.7	1497.4	1497.1	1496.0	1495.8	1495.2
4500	1502.1	1502.1	1501.9	1501.8	1502.1													1499.4	1499.2	1498.7
5000				1505.4														1503.1	1502.9	1502.5
5500																				
6000																				
6500																				
7000																				
7500																				

Depth in meters	Station number, latitude, and longitude																			
	61 38°29'S 94 14 W	62 34°35'S 91 52 W	63 32°10'S 89 04 W	64 31°54'S 88 17 W	65 31°07'S 86 39 W	66 27°04'S 84 01 W	67 24°57'S 82 15 W	68 21°28'S 80 26 W	69 16°49'S 78 39 W	70 13°53'S 77 54 W	71 11°57'S 78 37 W	72 9°58'S 82 10 W	73 10°45'S 84 57 W	74 11°00'S 87 24 W	75 14°15'S 92 05 W	76 15°18'S 97 28 W	77 14°20'S 103 12 W	78 13°02'S 108 03 W	79 12°36'S 112 14 W	80 12°39'S 117 22 W
0	1508.7	1515.8	1519.6	1519.9	1518.7	1516.8	1516.6	1516.6	1522.1	1522.2	1528.2	1531.9	1532.6	1530.3	1527.1	1528.4	1529.5	1531.5	1533.1	1535.3
25	1506.3	1515.2	1518.4	1518.7	1517.6	1516.4	1516.4	1516.7	1522.2	1521.3	1525.3	1531.8	1530.3	1529.8	1527.1	1528.6	1529.8	1531.6	1533.2	1535.6
50	1504.2	1513.2	1516.1	1516.4	1515.1	1515.5	1515.2	1516.3	1519.7	1517.3	1520.8	1527.9	1526.3	1526.6	1525.4	1528.0	1529.9	1531.5	1533.1	1535.6
75	1502.1	1510.5	1513.9	1514.1	1512.6	1514.8	1513.9	1515.1	1516.8	1512.2	1516.1	1523.1	1521.9	1522.8	1523.1	1527.3	1529.5	1530.8	1532.4	1535.0
100	1499.6	1507.9	1512.5	1512.6	1510.8	1514.7	1512.9	1513.8	1514.4	1508.6	1512.6	1519.3	1518.3	1519.6	1521.2	1526.7	1528.4	1529.9	1531.3	1534.0
200	1494.1	1501.3	1508.0	1507.6	1505.4	1512.6	1511.5	1508.1	1507.0	1502.8	1506.6	1510.3	1509.4	1510.8	1513.7	1523.1	1523.7	1525.5	1525.7	1529.5
300	1490.3	1496.3	1503.4	1502.6	1500.8	1508.3	1508.3	1503.2	1502.6	1500.5	1503.5	1505.7	1505.0	1505.7	1507.4	1517.4	1516.7	1519.0	1518.6	1522.8
400	1487.4	1492.3	1498.6	1498.1	1496.4	1503.5	1503.6	1499.7	1499.7	1498.4	1501.3	1502.6	1502.1	1502.6	1503.2	1511.5	1510.3	1512.4	1512.1	1516.0
500	1485.7	1489.9	1495.0	1494.8	1493.2	1499.6	1499.7	1496.7	1497.3	1496.5	1499.2	1500.3	1499.7	1500.2	1500.0	1506.8	1505.7	1507.6	1507.0	1510.5
1000	1482.5	1484.8	1487.4	1487.4	1486.2	1490.5	1490.6	1489.4	1490.6	1490.7	1492.5	1493.2	1492.9	1493.1	1492.0	1495.7	1494.8	1496.1	1495.5	1497.6
1500	1482.6	1483.9	1486.0	1485.7	1484.8	1488.0	1488.1	1487.4	1488.4	1488.6	1489.7	1490.2	1490.2	1490.2	1489.2	1491.9	1491.0	1492.0	1491.5	1492.9
2000	1484.1	1484.9	1486.7	1486.2	1485.7	1488.0	1488.1	1487.6	1488.3	1488.4	1489.3	1489.7	1489.7	1489.7	1488.9	1490.9	1490.3	1491.2	1490.6	1491.8
2500	1486.2	1487.0	1488.4	1488.0	1487.6	1489.4	1489.4	1489.0	1489.7	1489.7	1490.5	1490.7	1490.9	1490.9	1490.2	1491.8	1491.2	1491.9	1491.5	1492.5
3000	1489.2	1489.7	1490.9	1490.6	1490.2	1491.8	1491.8	1491.5	1492.0	1492.0	1492.6	1492.9	1492.9	1492.9	1492.3	1493.8	1493.2	1493.8	1493.5	1494.2
3500	1492.3	1492.8	1493.8	1493.5	1493.2	1494.5	1494.7	1494.4	1494.8	1495.0	1495.4	1495.5	1495.7	1495.7	1495.2	1496.4	1496.0	1496.4	1496.1	1496.7
4000	1495.5	1496.0	1497.1	1497.0	1496.7	1497.8	1497.8	1497.7	1498.1	1498.3	1498.6	1498.7	1498.9	1498.9	1498.4	1499.4	1499.0	1499.4	1499.2	1499.6
4500	1499.0	1499.4	1500.8	1500.6	1500.3	1501.3	1501.3	1501.3	1501.6	1501.8	1502.1	1502.2	1502.3	1502.3	1501.9	1502.8	1502.5	1502.9		
5000						1505.1	1505.1	1505.0	1505.4	1505.4	1505.7	1505.8	1506.0	1506.0	1505.7	1506.4	1506.1			
5500									1509.2	1509.3	1509.4	1509.7	1509.7			1510.2				
6000									1513.1	1513.2	1513.4	1513.7								
6500																				
7000																				
7500																				

Table 5—Sounding velocity in meters per second for *Carnegie* deep sea stations, 1928-1929—Continued
[The values appearing below the heavy line are based on extrapolated temperatures or salinities]

Depth in meters	Station number, latitude, and longitude																			
	81 13°03'S 121 12 W	82 14°52'S 126 07 W	83 17°00'S 129 45 W	84 17°11'S 133 18 W	85 17°12'S 136 37 W	86 17°36'S 141 55 W	87 18°05'S 145 33 W	88 16°42'S 150 41 W	89 17°09'S 152 41 W	90 16°35'S 155 45 W	91 15°44'S 160 25 W	92 15°18'S 163 14 W	93 14°41'S 167 41 W	94 12°47'S 171 35 W	95 8°43'S 170 56 W	96 6°47'S 172 23 W	97 3°47'S 172 39 W	98 0°18'N 173 59 W	99 4°22'N 176 23 W	100 8°05'N 178 48 W
0	1536.3	1538.3	1538.9	1539.5	1539.8	1540.5	1539.5	1540.8	1540.2	1540.3	1540.5	1540.2	1540.2	1541.8	1541.5	1541.9	1539.6	1536.9	1538.4	1537.7
25	1536.4	1538.4	1539.0	1539.6	1539.9	1540.3	1539.6	1540.9	1540.5	1540.5	1540.6	1540.2	1540.5	1541.9	1541.6	1542.1	1539.6	1537.0	1538.6	1537.9
50	1536.6	1538.7	1539.3	1539.8	1540.2	1540.2	1539.0	1541.1	1540.8	1540.8	1540.8	1540.5	1540.5	1542.1	1541.9	1542.2	1539.6	1537.0	1538.7	1538.0
75	1536.3	1538.2	1539.0	1539.0	1539.9	1539.5	1537.7	1540.8	1540.9	1540.8	1540.3	1540.3	1540.5	1542.1	1542.1	1542.4	1539.8	1537.1	1539.0	1538.3
100	1535.4	1537.1	1538.2	1537.9	1539.0	1538.4	1536.3	1539.9	1540.5	1540.2	1539.6	1539.9	1540.5	1542.2	1542.2	1542.2	1539.9	1537.3	1539.2	1538.4
200	1531.5	1533.8	1534.1	1535.1	1535.8	1535.0	1532.4	1535.8	1536.7	1536.7	1536.1	1536.3	1537.9	1539.2	1538.7	1539.0	1535.8	1536.6	1531.2	1528.0
300	1525.0	1527.1	1529.0	1530.8	1531.8	1530.8	1528.2	1531.2	1531.8	1532.1	1531.8	1531.1	1532.9	1533.2	1531.8	1531.2	1527.0	1530.2	1520.2	1516.4
400	1517.6	1519.3	1521.9	1523.7	1525.7	1525.0	1522.6	1525.3	1525.7	1526.0	1525.8	1524.5	1526.6	1526.0	1523.8	1522.1	1518.3	1521.8	1512.1	1509.9
500	1511.8	1512.8	1515.2	1516.7	1518.9	1518.9	1516.7	1518.9	1519.5	1519.7	1519.5	1518.0	1520.3	1519.0	1517.0	1515.0	1513.1	1515.4	1507.0	1505.7
1000	1498.0	1497.8	1499.2	1500.2	1501.2	1502.2	1500.6	1501.6	1502.2	1502.5	1501.9	1500.6	1503.1	1501.5	1500.8	1499.3	1497.8	1500.5	1495.8	1495.8
1500	1493.2	1493.1	1494.1	1494.5	1495.2	1495.7	1494.8	1495.1	1495.5	1496.0	1495.5	1494.5	1496.1	1495.4	1495.2	1493.9	1493.2	1495.0	1491.9	1492.0
2000	1491.9	1491.8	1492.6	1492.9	1493.4	1493.5	1493.1	1493.2	1493.6	1493.8	1493.6	1492.8	1493.9	1493.5	1493.5	1492.5	1492.0	1493.4	1491.0	1491.2
2500	1492.5	1492.3	1493.1	1493.2	1493.6	1493.8	1493.5	1493.5	1493.9	1494.1	1493.8	1493.2	1494.1	1493.8	1493.8	1492.9	1492.6	1493.6	1491.8	1491.9
3000	1494.2	1494.1	1494.7	1494.8	1495.2	1495.4	1495.1	1495.1	1495.4	1495.5	1495.4	1495.0	1495.5	1495.2	1495.2	1494.7	1494.2	1495.2	1493.6	1493.8
3500	1496.7	1496.5	1497.1	1497.3	1497.6	1497.7	1497.4	1497.4	1497.7	1497.8	1497.7	1497.3	1497.8	1497.6	1497.6	1497.1	1496.7	1497.6	1496.3	1496.3
4000	1499.6	1499.4	1500.0	1500.0	1500.3	1500.5	1500.2	1500.2	1500.5	1500.6	1500.5	1500.0	1500.6	1500.5	1500.5	1499.9	1499.6	1500.3	1499.2	1499.3
4500	1502.8	1502.6	1503.1	1503.2	1503.5	1503.5	1503.4	1503.4	1503.5	1503.6	1503.5	1503.2	1503.6	1503.4	1503.5	1503.2	1502.9	1503.5	1502.5	1502.6
5000				1506.6		1506.8			1506.8	1507.0	1506.8	1506.6	1506.8	1506.7	1507.0	1506.7	1506.4	1507.0	1506.0	1506.1
5500										1510.5	1510.3	1510.0	1510.3	1510.2	1510.6	1510.3	1510.0	1510.6	1509.7	1509.7
6000											1513.9	1513.8	1513.8			1514.1	1513.8	1514.4	1513.5	1513.5
6500												1517.4								1517.6
7000																				
7500																				

Depth in meters	Station number, latitude, and longitude																			
	101 13°23'N 177 27 E	102 16°25'N 171 59 E	103 19°19'N 166 23 E	104 20°12'N 161 19 E	105 18°43'N 156 16 E	106 16°14'N 151 04 E	107 14°05'N 146 06 E	108 18°26'N 144 01 E	109 23°22'N 144 08 E	110 26°20'N 144 24 E	111 31°00'N 144 16 E	112 33°51'N 141 15 E	113 34°44'N 141 04 E	114 36°38'N 143 34 E	115 37°40'N 145 26 E	116 38°41'N 147 41 E	117 40°20'N 150 58 E	118 42°29'N 155 24 E	119 45°24'N 159 36 E	120 47°02'N 166 20 E
0	1534.5	1533.7	1534.2	1534.5	1536.1	1536.9	1538.2	1539.6	1537.3	1528.4	1518.4	1526.8	1529.2	1517.6	1519.7	1506.0	1506.1	1485.8	1472.5	1473.5
25	1534.7	1533.8	1534.2	1534.7	1536.3	1537.0	1538.4	1539.3	1537.1	1524.2	1518.2	1527.0	1529.2	1516.6	1519.3	1504.7	1504.4	1481.9	1470.9	1470.3
50	1534.8	1534.1	1534.4	1534.7	1536.4	1537.1	1538.6	1538.6	1534.7	1520.8	1517.9	1526.3	1529.2	1514.1	1517.3	1500.3	1501.8	1480.2	1467.1	1465.4
75	1534.8	1534.2	1534.4	1534.8	1536.6	1536.9	1538.6	1537.7	1531.5	1518.7	1517.4	1525.1	1528.9	1511.0	1515.1	1495.4	1498.3	1479.1	1462.9	1461.3
100	1534.7	1534.4	1534.2	1534.7	1536.1	1536.4	1538.4	1536.9	1528.9	1517.6	1517.0	1524.0	1528.2	1508.3	1513.5	1491.2	1495.1	1477.7	1460.2	1459.4
200	1531.9	1534.0	1532.4	1531.9	1532.8	1533.5	1535.8	1533.8	1521.9	1515.5	1515.2	1520.5	1524.5	1501.0	1508.0	1481.3	1487.0	1474.1	1458.6	1458.7
300	1524.7	1529.6	1528.3	1527.3	1528.2	1529.0	1529.6	1529.6	1517.9	1514.7	1513.4	1518.0	1520.5	1496.0	1503.5	1477.3	1482.2	1472.0	1460.2	1460.2
400	1516.6	1522.2	1523.5	1522.5	1523.1	1523.1	1521.6	1524.8	1514.8	1513.5	1510.6	1516.1	1515.7	1492.0	1498.4	1475.5	1479.3	1471.2	1461.5	1461.5
500	1510.6	1515.4	1518.6	1517.9	1518.2	1517.1	1515.0	1520.3	1511.6	1511.6	1506.8	1513.9	1511.0	1489.3	1493.2	1474.6	1477.8	1470.6	1462.5	1462.6
1000	1497.3	1499.3	1502.5	1502.8	1502.8	1501.6	1499.3	1505.1	1499.7	1500.8	1494.7	1502.2	1496.7	1482.8	1483.5	1474.2	1476.1	1471.5	1466.7	1466.8
1500	1492.8	1493.8	1495.8	1496.1	1496.1	1495.7	1494.2	1497.7	1493.8	1494.4	1490.2	1495.4	1491.3	1481.5	1482.3	1475.8	1477.3	1473.9	1470.3	1470.4
2000	1491.5	1492.2	1493.6	1493.8	1493.8	1493.8	1492.6	1495.1	1492.0	1492.3	1489.2	1493.2	1490.0	1482.6	1483.4	1478.3	1479.4	1477.0	1474.1	1474.2
2500	1492.2	1492.6	1493.8	1493.9	1493.9	1493.9	1493.1	1495.0	1492.5	1492.6	1490.2	1493.4	1490.9	1484.8	1485.4	1481.5	1482.3	1480.4	1478.0	1478.1
3000	1493.9	1494.4	1495.2	1495.2	1495.4	1495.4	1494.7	1496.3	1494.1	1494.2	1492.0	1494.8	1492.8	1487.7	1488.3	1484.8	1485.7	1484.1	1482.0	1482.2
3500	1496.4	1496.7	1497.6	1497.6	1497.7	1497.6	1497.0	1498.4	1496.5	1496.7	1494.8	1497.1	1495.4	1491.0	1491.5	1488.6	1489.3	1487.8	1486.1	1486.2
4000	1499.3	1499.6	1500.5	1500.5	1500.5	1500.5	1499.9	1501.0	1499.4	1499.6	1497.8	1499.9	1498.4	1494.7	1495.0	1492.5	1493.1	1491.9	1490.3	1490.5
4500	1502.6	1502.9	1503.5	1503.5	1503.6	1503.6	1503.1	1504.2	1502.6	1502.8	1501.3	1503.1	1501.8	1498.4	1498.7	1496.5	1497.0	1496.0	1494.7	1494.7
5000	1506.1	1506.4	1507.0	1507.0	1507.0	1507.0	1506.6	1507.6	1506.1	1506.3	1505.0	1506.6	1505.4	1502.3	1502.6	1500.6	1501.0	1500.2	1498.9	1499.0
5500	1509.9	1510.0	1510.6	1510.6	1510.6	1510.6	1510.2		1509.7	1509.9	1508.7	1510.2	1509.0	1506.3	1506.6	1504.8	1505.2	1504.4	1503.2	1503.2
6000	1513.7	1513.8	1514.4	1514.4	1514.4	1514.4	1513.9		1513.7	1513.7	1512.6	1513.9	1512.9	1510.5	1510.6	1509.0	1509.4	1508.6	1507.6	1507.6
6500					1518.2	1518.2	1517.9		1517.4	1517.6	1516.6	1517.9	1516.8	1514.5					1511.9	1511.9
7000						1522.2	1521.9		1521.5		1520.6	1521.8	1520.9	1518.7						1516.4
7500						1526.1[a]	1525.8[b]		1525.5[c]				1525.0[d]	1522.9[e]						

a) 1530.2, 1534.4 at 8000, 8500

b) 1530.0, 1534.1 at 8000, 8500

c) 1529.6, 1533.8, 1537.9 at 8000, 8500, 9000

d) 1529.2 at 8000

e) 1527.3 at 8000

Table 5—Sounding velocity in meters per second for *Carnegie* deep sea stations, 1928-1929—Concluded

[The values appearing below the heavy line are based on extrapolated temperatures or salinities]

Depth in meters	121 46°05'N 171 32 E	122 46°16'N 174 03 E	123 50°27'N 172 51 W	124 52°19'N 162 02 W	125 51°58'N 150 39 W	126 48°05'N 143 56 W	127 44°16'N 137 37 W	128 40°37'N 132 23 W	129 38°50'N 126 02 W	130 37°05'N 123 43 W	131 33°49'N 126 20 W	132 31°38'N 128 48 W	133 29°21'N 132 30 W	134 27°45'N 135 22 W	135 26°39'N 139 07 W	136 26°13'N 142 02 W	137 24°02'N 145 33 W	138 22°53'N 151 15 W	139 21°47'N 155 31 W	140 23°26'N 159 27 W	141 29°02'N 161 11 W
0	1474.5	1477.4	1477.0	1481.3	1486.0	1488.4	1495.8	1505.8	1505.7	1506.0	1514.5	1520.3	1525.5	1526.0	1528.7	1531.1	1532.9	1534.2	1536.6	1536.1	1534.1
25	1472.6	1475.8	1477.0	1480.4	1485.4	1488.6	1496.0	1504.1	1505.8	1505.1	1512.6	1520.5	1525.7	1526.1	1528.9	1531.1	1533.1	1534.4	1535.8	1536.3	1534.3
50	1468.8	1471.5	1473.5	1476.8	1480.7	1485.5	1493.8	1500.5	1506.0	1501.5	1508.7	1518.2	1524.7	1524.3	1527.7	1529.2	1532.6	1534.2	1535.6	1536.4	1533.8
75	1464.9	1467.0	1469.4	1472.8	1475.8	1481.8	1490.3	1496.8	1504.8	1497.0	1505.1	1514.4	1522.8	1521.8	1525.7	1526.6	1531.3	1532.9	1534.5	1536.7	1532.3
100	1462.3	1464.2	1466.8	1470.3	1472.9	1479.3	1487.7	1494.4	1502.2	1493.6	1502.6	1511.3	1521.2	1520.0	1523.8	1524.5	1529.8	1531.5	1533.1	1536.6	1530.0
200	1459.9	1460.6	1463.6	1467.1	1468.3	1476.0	1483.1	1489.2	1494.7	1487.7	1497.3	1502.8	1515.7	1516.1	1518.4	1518.4	1524.5	1528.3	1525.7	1533.9	1521.9
300	1460.9	1460.6	1463.6	1466.5	1467.1	1474.8	1481.0	1486.1	1490.2	1484.9	1493.8	1496.8	1509.3	1510.5	1512.1	1512.4	1517.9	1523.4	1517.7	1527.1	1515.7
400	1462.2	1461.6	1464.1	1466.5	1466.8	1473.8	1479.3	1483.9	1487.0	1483.4	1490.5	1492.9	1503.4	1504.4	1505.7	1506.7	1511.2	1516.7	1510.9	1520.2	1511.0
500	1463.0	1462.8	1464.6	1466.8	1467.1	1473.1	1478.0	1482.2	1484.8	1482.2	1488.0	1490.0	1498.9	1499.7	1500.8	1501.9	1505.8	1510.5	1505.4	1513.7	1507.3
1000	1467.1	1467.0	1468.0	1469.4	1469.4	1473.2	1476.1	1478.9	1481.3	1480.3	1483.1	1484.4	1489.2	1489.7	1490.0	1490.7	1493.4	1496.1	1493.1	1497.8	1495.5
1500	1470.7	1470.7	1471.5	1472.3	1472.6	1475.2	1477.3	1479.3	1481.6	1480.7	1482.5	1483.5	1486.8	1487.4	1487.3	1487.8	1489.7	1491.8	1489.6	1492.6	1490.9
2000	1474.4	1474.4	1474.9	1475.7	1476.0	1478.0	1479.6	1481.2	1483.1	1482.3	1483.6	1484.5	1487.0	1487.6	1487.3	1487.7	1489.3	1490.9	1489.2	1491.3	1490.0
2500	1478.3	1478.3	1478.7	1479.3	1479.7	1481.2	1482.5	1483.8	1485.2	1484.7	1485.8	1486.5	1488.6	1489.0	1488.7	1489.0	1490.3	1491.6	1490.2	1492.0	1490.7
3000	1482.3	1482.2	1482.6	1483.1	1483.5	1484.7	1485.8	1486.8	1488.1	1487.7	1488.6	1489.2	1490.9	1491.2	1490.9	1491.2	1492.3	1493.5	1492.3	1493.8	1492.6
3500	1486.4	1486.4	1486.7	1487.1	1487.4	1488.4	1489.3	1490.3	1491.5	1490.9	1491.8	1492.3	1493.6	1494.1	1493.8	1494.1	1495.1	1496.0	1495.0	1496.3	1495.2
4000	1490.6	1490.5	1490.9	1491.2	1491.5	1492.3	1493.2	1493.9	1495.0	1494.5	1495.2	1495.7	1497.0	1497.3	1497.0	1497.3	1498.1	1499.0	1498.0	1499.2	1498.3
4500	1494.8	1494.8	1495.1	1495.4	1495.5	1496.4	1497.1	1497.8	1498.7	1498.4	1499.0	1499.4	1500.5	1500.8	1500.6	1500.8	1501.5	1502.3	1501.5	1502.5	1501.8
5000	1499.0	1499.0	1499.3	1499.6	1499.7	1500.5		1501.8		1502.3	1502.8	1503.2	1504.2	1504.5	1504.2	1504.5	1505.1	1505.8	1505.1	1506.0	1505.4
5500	1503.4	1503.4	1503.5	1503.8										1508.3	1508.1	1508.3	1508.9	1509.4	1508.9	1509.7	1509.0
6000	1507.7	1507.7	1507.9														1512.8	1513.4	1512.8	1513.5	1512.9
6500	1512.1	1512.1															1516.7				1516.8
7000																					
7500																					

Depth in meters	142 32°42'N 160 44 W	143 34°06'N 157 09 W	144 33°38'N 151 47 W	145 33°27'N 145 30 W	146 31°51'N 140 50 W	147 27°27'N 138 14 W	148 24°57'N 137 44 W	149 21°18'N 138 36 W	150 16°15'N 137 06 W	151 12°40'N 137 32 W	152 10°05'N 139 44 W	153 7°45'N 141 24 W	154 6°42'N 143 22 W	155 4°51'N 146 46 W	156 3°01'N 149 46 W	157 1°48'S 152 22 W	158 6°33'S 154 58 W	159 9°24'S 159 01 W	160 10°54'S 161 53 W	161 12°04'S 164 57 W	162 13°36'S 168 23 W
0	1529.2	1524.7	1527.3	1524.2	1524.8	1527.7	1527.9	1528.0	1532.8	1532.9	1536.1	1538.2	1538.7	1538.0	1537.7	1536.9	1539.5	1540.9	1540.5	1540.8	1540.5
25	1528.9	1524.8	1527.4	1524.5	1525.1	1528.0	1528.0	1528.2	1532.8	1528.4	1528.0	1538.4	1538.7	1538.2	1537.9	1537.0	1539.8	1541.1	1540.8	1540.9	1539.3
50	1527.7	1522.5	1526.1	1522.4	1525.4	1528.0	1528.0	1528.3	1531.2	1523.7	1519.3	1538.6	1538.7	1538.4	1537.7	1537.3	1539.9	1541.2	1541.1	1541.1	1538.6
75	1524.7	1518.3	1523.2	1519.0	1525.5	1526.8	1527.0	1527.6	1528.9	1518.4	1512.5	1538.7	1539.0	1538.4	1537.6	1537.6	1540.2	1541.4	1541.2	1540.0	1538.0
100	1521.3	1514.4	1520.3	1516.3	1524.7	1525.1	1525.4	1526.3	1526.6	1513.7	1508.0	1536.7	1538.4	1538.4	1537.3	1537.7	1540.3	1541.4	1541.4	1540.3	1537.6
200	1513.2	1506.4	1512.1	1509.7	1519.7	1518.2	1521.3	1521.9	1516.4	1504.2	1500.0	1522.1	1526.6	1529.2	1530.6	1528.6	1535.3	1537.9	1539.6	1535.8	1534.4
300	1508.3	1502.3	1506.6	1504.8	1513.8	1511.0	1515.1	1515.8	1508.6	1500.2	1497.0	1512.2	1515.2	1518.3	1521.3	1519.0	1526.3	1530.8	1534.5	1529.5	1529.9
400	1504.8	1499.3	1502.8	1500.9	1507.9	1505.1	1508.1	1508.9	1503.6	1497.8	1495.2	1506.8	1508.9	1511.6	1514.4	1513.8	1518.4	1523.1	1526.8	1522.2	1523.7
500	1501.9	1496.5	1499.6	1497.4	1503.1	1500.6	1502.8	1503.8	1500.0	1496.1	1493.9	1503.2	1504.8	1507.1	1509.6	1509.6	1512.6	1516.4	1519.2	1515.7	1517.4
1000	1492.8	1488.6	1490.5	1488.3	1491.8	1490.0	1491.5	1492.9	1491.5	1490.9	1489.9	1494.4	1495.2	1496.4	1497.6	1497.6	1499.0	1500.6	1501.3	1499.9	1501.0
1500	1489.0	1486.0	1487.3	1485.7	1488.4	1487.4	1488.4	1489.9	1488.9	1488.7	1488.1	1491.2	1491.9	1492.5	1493.1	1492.9	1494.1	1495.0	1495.5	1494.4	1495.0
2000	1488.6	1486.1	1487.1	1486.0	1488.0	1487.4	1488.3	1489.4	1488.6	1488.6	1488.3	1490.6	1491.2	1491.5	1491.9	1491.8	1492.8	1493.2	1493.6	1492.6	1493.2
2500	1489.6	1487.7	1488.4	1487.6	1489.3	1488.7	1489.4	1490.5	1489.7	1489.7	1489.6	1491.5	1491.9	1492.2	1492.6	1492.5	1493.2	1493.5	1493.8	1493.1	1493.6
3000	1491.8	1490.2	1490.7	1490.0	1491.5	1491.0	1491.6	1492.3	1491.9	1491.9	1491.8	1493.4	1493.8	1494.1	1494.4	1494.2	1495.0	1495.1	1495.4	1494.8	1495.1
3500	1494.5	1493.1	1493.6	1493.1	1494.2	1493.8	1494.4	1495.1	1494.7	1494.8	1494.5	1496.0	1496.3	1496.5	1496.7	1496.7	1497.3	1497.4	1497.7	1497.1	1497.4
4000	1497.6	1496.4	1496.8	1496.4	1497.4	1497.1	1497.6	1498.1	1497.8	1497.8	1497.7	1498.9	1499.3	1499.4	1499.6	1499.6	1500.0	1500.2	1500.5	1500.0	1500.3
4500	1501.0	1500.0	1500.5	1500.0	1500.9	1500.6	1501.0	1501.5	1501.2	1501.2	1501.0	1502.2	1502.5	1502.6	1502.8	1502.8	1503.2	1503.4	1503.5	1503.1	1503.4
5000	1504.7	1503.8	1504.1	1503.8	1504.5	1504.4	1504.7	1505.1	1504.8	1504.8	1504.7	1505.7	1506.0	1506.0	1506.3	1506.1	1506.6	1506.7		1506.3	1506.6
5500	1508.6	1507.7	1508.0	1507.6	1508.4	1508.1	1508.4	1508.9	1508.6	1508.6	1508.4	1509.3	1509.6	1509.7	1509.7	1509.7	1510.2	1510.3		1509.7	1510.0
6000	1512.5	1511.6	1511.9	1511.6					1512.4								1513.8	1513.9		1513.5	1513.7
6500	1516.4	1515.7																1517.6			
7000																					
7500																					

ABSTRACT OF LOG

ABSTRACT OF LOG

Date	Noon position		Day's run	Current		Remarks
	Latitude	Longitude east		Dir.	Am't.	
						Washington, D. C. to Plymouth, England
						Total distance, 3669; time of passage, 29.3 days; average day's run, 125.2 miles
1928	° ′	° ′	miles	°	miles	
May 1	Washington, D.C.		.....	....	.....	Left Colonial Beach Steamboat Co. pier under tow at 09h 00m.
2	St. Mary's River		.....	....	.....	Anchored at entrance St. Mary's River, Chesapeake Bay, at 00h 20m off Kitts Point. Swung ship for declination-observations and deviation. Clear. Light variable breeze.
3	St. Mary's River		.....	....	.....	Atmospheric-electric observations. Clear. Light NW air.
4	St. Mary's River		.....	....	.....	Atmospheric-electric observations. Clear. Calm.
5	St. Mary's River		.....	....	.....	Atmospheric-electric observations. Clear. Calm. Under way 20h 30m with pilot.
6	Newport News		.....	....	.....	Anchored at 08h 30m. Overcast. Fresh northerly breeze.
7	Newport News		.....	....	.....	In drydock of Newport News Shipbuilding and Drydock Co. at 10h 10m. Cloudy to clear. Fresh northerly breeze.
8	Newport News		.....	....	.....	In drydock. Overcast. Rain. Strong NE breeze.
9	Newport News		.....	....	.....	In drydock. Overcast. Rain. Calm.
10	Newport News		.....	....	.....	Under way at 13h 15m with pilot. Took departure from Cape Henry at 18h 20m. Gentle SE breeze. Partly cloudy.
11	37 15 N	286 09	134	244	7.5	Clear to cloudy. Smooth to moderate sea. Moderate southerly breeze.
12	38 17 N	291 56	282	61	6.4	Cloudy to overcast. Moderate to choppy sea. Moderate to fresh breeze, S in a.m., NE in p.m.
13	37 43 N	296 37	221	89	69.0	Partly cloudy. Moderate sea and northerly wind.
14	37 00 N	299 40	149	220	44.8	Overcast, rain. Gentle to fresh northerly breeze. Moderate sea.
15	37 04 N	303 24	179	295	30.0	Overcast, rain. Fresh northerly breeze. Choppy sea.
16	37 48 N	306 50	170	231	18.3	Partly cloudy. Moderate to fresh NW breeze. Moderate and broken and choppy sea.
17	38 12 N	310 21	168	225	27.6	Partly cloudy. Moderate sea. Rain squalls. Moderate breeze, NW in a.m., SW in p.m.
18	39 11 N	314 29	202	36	19.8	Cloudy, rain. Strong southerly breeze to moderate gale. Rough sea.
19	40 38 N	318 11	191	16	19.4	Partly cloudy. Fresh southerly breeze. Rough to choppy sea, squalls.
20	42 01 N	321 13	161	337	15.3	Cloudy. Fresh southerly breeze. Moderate choppy sea. Squalls.
21	44 04 N	323 54	170	19	9.2	Cloudy. Moderate southerly breeze. Moderate sea.
22	45 29 N	326 40	146	310	11.5	Cloudy. Moderate sea. Moderate to gentle SE breeze.
23	44 35 N	326 53	54	212	27.2	Overcast. Rain. Moderate to strong NE breeze. Moderate to rough sea.
24	43 51 N	328 18	75	229	10.2	Overcast. Heavy rain. Strong NE breeze to fresh gale. Rough sea.
25	43 13 N	328 30	40	260	31.5	Cloudy. Fresh NE breeze. Moderate sea, broken, and choppy.
26	44 00 N	331 35	144	153	15.4	Cloudy. Fresh northerly breeze. Moderate sea.
27	45 50 N	334 29	164	176	13.3	Cloudy. Fresh NW and SW breezes. Moderate to rough sea.
28	48 11 N	338 52	230	66	14.7	Overcast. Strong northerly breeze to moderate gale. Choppy sea.
29	48 50 N	341 10	101	197	12.4	Clear in p.m. Moderate sea. Moderate southerly breeze.
30	49 37 N	344 24	138	340	4.7	Overcast. Fog. Rain. Moderate southerly breeze and sea.
31	50 23 N	346 29	92	12	2.9	Overcast. Fog. Rain. Moderate sea. Gentle SE breeze.
June 1	50 06 N	346 54	24	42	3.9	Cloudy to overcast. Misty. Moderate sea. Moderate E to SE breeze.
2	49 32 N	347 53	51	289	10.2	Cloudy. Fresh to strong easterly breeze. Moderate to rough sea.
3	50 12 N	347 29	43	159	5.0	Cloudy to overcast. Fog. Rain. Strong to light SE breeze. Choppy sea.
4	50 16 N	347 55	17	160	16.6	Cloudy to overcast. Fog. Rain. Gentle to strong easterly breeze. Choppy sea.
5	49 55 N	348 52	42	4	3.8	Cloudy to overcast. Moderate easterly breeze. Moderate sea. Southerly swell.
6	50 10 N	349 56	44	295	3.1	Cloudy. Squalls. Light to fresh SE breeze. Moderate sea.
7	50 12 N	352 04	82	6	6.3	Cloudy to overcast. Gentle southerly breeze. Rain. Moderate sea.
8	49 59 N	354 57	112	100	1.7	Slightly cloudy in a.m., overcast in p.m. W to SW light winds in a.m. Moderate sea. Rain and strong wind in p.m.
8	Plymouth		.....	....	.....	Anchored in Plymouth harbor at 20h 30m.
						Plymouth, England to Hamburg, Germany
						Total distance, 614 miles; time of passage, 4.1 days; average day's run, 149.8 miles
1928	° ′	° ′	miles	°	miles	
June 18	Plymouth		.....	....	.....	Took departure from Plymouth Breakwater at 16h 38m. Cloudy. Moderate sea. Gentle W to SW and S breeze.
19	50 29 N	358 59	126	20	6.3	Overcast. Gentle to moderate SW to W breeze. Smooth to moderate sea.
20	51 39 N	2 24	146	120	15.8	Partly cloudy. Moderate W to NW breeze. Moderate sea.
21	53 23 N	4 24	128	40	12.6	Partly cloudy. Moderate northerly breeze in morning. Gentle southerly breeze in afternoon. Moderate sea.

Plymouth, England to Hamburg, Germany--Concluded

Date	Noon position		Day's run	Current		Remarks
	Latitude	Longitude east		Dir.	Am't.	
1928	° ′	° ′	miles	°	miles	
June 22	Mouth of Elbe River, Germany		137	18	6.3	Arrived at Elbe lightship no. 1 at 10h 12m. Overcast. Moderate southerly breeze. Moderate sea.
22	Hamburg		77	....	.....	Picked up pilot at Elbe lightship no. 1. Picked up tug at Altenbruck Towed 54 miles to Hamburg Harbor, Jonas Dock, Vorsetzen. Anchored at 20h 00m.

Hamburg, Germany to Reykjavik, Iceland

Total distance, 1329 miles; time of passage, 13.0 days; average day's run, 102.3 miles

Date	Latitude	Longitude east	Day's run	Dir.	Am't.	Remarks
1928	° ′	° ′	miles	°	miles	
July 7 8	Hamburg		96	....	.....	Left Hamburg Harbor at 07h 00m. Under tow from Harbor to Helgoland. Took departure from Helgoland at 08h 35m July 8. Partly cloudy. Gentle westerly breeze. Moderate sea. Tow distance 96 miles.
8	54 09 N	7 38	5	49	3.0	Partly cloudy. Gentle westerly breeze. Moderate sea.
9	55 21 N	5 13	110	42	9.6	Partly cloudy. Fresh to light WSW breeze. Moderate to smooth sea.
10	58 00 N	2 25	185	56	16.0	Cloudy in morning. Overcast and drizzling in afternoon. Fresh W to SSW breeze. Moderate to choppy sea.
11	60 29 N	0 24	162	67	20.2	Overcast and misty. Fresh W to SW breeze. Moderate to choppy sea.
12	62 16 N	354 59	169	43	14.2	Partly cloudy. Strong SW breeze. Moderate to choppy sea.
13	63 16 N	350 40	133	34	23.2	Partly cloudy. Strong SW breeze. Choppy, rough sea.
14	64 05 N	348 22	79	5	7.2	Cloudy to overcast. Squalls. Strong SW breeze in morning. Very light NE air in afternoon. Rough sea to moderate.
15	63 28 N	345 07	93	337	11.2	Partly cloudy. Light easterly air in morning. Gentle to moderate SW breeze in afternoon. Smooth to moderate sea.
16	63 20 N	342 46	64	31	13.6	Partly cloudy. Moderate westerly breeze. Moderate to choppy sea.
17	62 57 N	341 36	39	84	10.6	Overcast in morning. Rain. Cloudy in afternoon. Moderate westerly and fresh NW breeze. Moderate choppy to rough sea.
18	62 33 N	340 09	46	153	14.4	Cloudy in morning. Overcast and misty in afternoon. Moderate W to NW breeze. Moderate, choppy sea.
19	63 38 N	338 00	87	64	12.8	Overcast. Misty to drizzling. Moderate NW breeze. Moderate sea. Squally.
20	Reykjavik		61	150	16.0	Overcast and drizzling. Gentle westerly breeze. Smooth sea. At anchor in Reykjavik harbor at 08h 00m.

Reykjavik, Iceland to Barbados, B.W.I.

Total distance, 5715 miles; time of passage, 51.8; average day's run, 110.3 miles

Date	Latitude	Longitude east	Day's run	Dir.	Am't.	Remarks
1928	° ′	° ′	miles	°	miles	
July 27	Reykjavik		.....	....	.....	Left at 12h 00m with own power. Partly cloudy. Moderate sea and moderate NE to N breeze.
28	62 31 N	333 42	156	154	7	Cloudy in early morning and evening. Clear during day. Moderate sea. Moderate northwesterly breeze.
29	60 40 N	328 45	180	144	14	Cloudy to overcast. Moderate sea. Moderate north breeze.
30	59 17 N	325 45	122	180	14	Overcast in morning. Cloudy in afternoon. Light to moderate N to W breezes. Smooth to choppy sea.
31	57 54 N	325 50	83	72	6	Cloudy to overcast. Moderate to gentle NW to SW breezes. Moderate sea.
Aug. 1	58 15 N	324 10	57	359	15	Fog, mist, and drizzling rain. Overcast. Gentle SW to NW breezes. Moderate sea.
2	58 16 N	321 18	91	153	2	Overcast and misty. Calm to fresh E and NE breezes. Moderate to choppy sea. Squalls.
3	57 52 N	314 27	219	324	4	Aurora borealis in early hours. Cloudy until evening then overcast and misty. Strong NE to E breezes. Choppy to rough sea.
4	54 30 N	310 59	233	292	15	Aurora borealis in late evening. Overcast in morning. Cloudy in afternoon. Strong E to NE breezes. Rough sea. Squalls.
5	51 38 N	310 28	174	244	14	Clouds on horizons. Moderate NE to NW breezes. Moderate sea. Iceberg abeam at 19h 35m.
6	48 26 N	311 51	199	137	12	Cloudy. Moderate WNW breeze. Moderate sea. Aurora borealis in late evening.
7	45 54 N	312 07	153	172	5	Clear during day. Few clouds on horizons in early evening. Moderate to fresh NW to W breeze. Moderate sea.
8	43 14 N	313 06	165	77	9	Cloudy, but principally on horizons. Moderate NW breeze in morning and moderate sea. Gentle NE breeze in afternoon and smooth sea.
9	42 10 N	312 39	67	139	2	Cloudy. Light NE breeze in morning and smooth sea. Moderate to fresh SE breeze and moderate sea in afternoon.
10	39 48 N	311 11	156	343	25	Cloudy to overcast. Rain and mist in middle of day. Fresh to strong SE breeze and rough sea in morning, gentle breeze in afternoon.
11	38 38 N	311 14	70	91	15	Cloudy. Calm to gentle W breeze. Moderate sea.

Reykjavik, Iceland to Barbados, B.W.I.--Concluded

Date	Noon position		Day's run	Current		Remarks
	Latitude	Longitude east		Dir.	Am't.	
1928	° ′	° ′	miles	°	miles	
Aug. 12	36 58 N	311 42	103	157	17	Cloudy on horizons. Light to gentle W and SW breezes. Moderate to smooth sea.
13	36 48 N	313 34	91	85	33	Squalls in early morning. Cloudy on horizons during day. Moderate S to W breezes. Moderate sea.
14	35 14 N	315 41	139	90	16	Cloudy. Squalls in early morning. Moderate SW breeze. Moderate sea.
15	33 36 N	317 45	142	64	15	Cloudy on horizons and occasionally overhead with squalls and lightning. Moderate westerly breeze. Choppy sea.
16	31 10 N	318 56	157	117	23	Cloudy. Squalls in afternoon. Fresh to light W to NW breeze. Moderate sea.
17	29 45 N	319 24	88	160	17	Cloudy. Squalls in early morning. Clear overhead during day. Light to gentle N to E breeze. Smooth sea.
18	27 54 N	320 32	126	264	7	Cloudy on horizons with distant squalls. Gentle to fresh E breeze. Smooth to moderate sea.
19	25 39 N	321 01	137	310	6	Cloudy on horizons. Moderate to gentle SE breeze. Moderate to smooth sea.
20	23 59 N	320 23	105	65	5	Cloudy, with squall conditions. Moderate to fresh breeze in morning, gentle in afternoon. Moderate sea.
21	21 46 N	320 22	134	292	11	Cloudy on horizons. Fresh E breeze. Moderate to choppy sea.
22	19 12 N	321 31	167	255	6	Cloudy. Fresh to moderate E breeze. Moderate sea. Squalls; threatening during day.
23	16 35 N	322 10	162	215	12	Cloudy, chiefly on horizons. Moderate E breeze and moderate sea in morning. Light ENE airs and smooth sea in afternoon and evening.
24	15 48 N	322 03	47	206	20	Cloudy, chiefly on horizons. Calm to light E airs. Smooth sea.
25	14 56 N	321 50	54	218	20	Cloudy. Light ESE breeze in morning; calm thereafter. Smooth sea. Started main engine at 19h 20m.
26	13 55 N	321 58	61	161	2	Cloudy. Light E airs in morning. Light W breeze in afternoon. Smooth sea. Rain in morning and evening. Stopped engine at 08h 10m.
27	13 22 N	322 00	33	184	17	Cloudy, chiefly on horizons. Calm to light west airs. Smooth sea. Started main engine at 19h 25m.
28	11 54 N	322 08	89	184	9	Clear in early morning, cloudy thereafter. Squall in evening. Light W to SW airs and breeze. Smooth sea. Stopped main engine at 08h 00m, and started again at 20h 10m.
29	10 49 N	322 36	70	158	12	Cloudy. Light variable airs, to calm. Smooth sea. Squalls morning and evening. Stopped engine at 05h 55m and started again at 20h 15m.
30	9 28 N	322 52	83	122	10	Cloudy. Calm to light and gentle SW breezes. Smooth to moderate sea. Stopped engine at 11h 20m. Rain at midnight.
31	8 11 N	323 52	97	79	17	Squalls throughout day. Gentle to fresh westerly breeze. Moderate to choppy sea.
Sep. 1	9 26 N	323 20	81	57	25	Overcast and raining, morning and evening, otherwise cloudy. Gentle W breeze until evening, then calm. Moderate sea.
2	9 50 N	323 20	24	113	17	Cloudy, chiefly on horizons. Light to moderate westerly breeze. Smooth to moderate sea. Squall at midnight.
3	11 07 N	322 52	82	60	15	Rain morning and evening with lightning in evening. Cloudy during day. Gentle westerly breeze, to calm. Moderate to smooth sea.
4	11 23 N	321 57	57	227	18	Squall in early morning. Cloudy, chiefly on horizons. Light to moderate NE breeze. Smooth to moderate sea.
5	11 33 N	319 10	164	264	18	Cloudy, chiefly on horizons. Moderate to gentle NE breeze. Moderate sea.
6	11 40 N	317 24	105	344	1	Cloudy, chiefly on horizons. Gentle NNE to NxE breeze. Moderate sea. Heavy squall at 19h 00m.
7	11 18 N	315 42	103	202	25	Cloudy, chiefly on horizons. Light NxE breeze to light NNE airs. Moderate to smooth sea. NE swells.
8	11 36 N	314 54	51	296	33	Clear in morning, cloudy in afternoon. Light NE airs to calm. Smooth sea. NE swells.
9	11 45 N	313 53	60	214	12	Cloudy, chiefly on horizons, until evening; then rain squalls. Gentle to light northerly breeze. Moderate sea.
10	12 10 N	312 15	99	257	20	Heavy squalls during morning, cloudy thereafter. Moderate to fresh westerly breeze. Moderate to choppy sea.
11	13 13 N	310 19	130	20	22	Squalls threatening in morning, then cloudy chiefly on horizons. Moderate to light SW breeze. Choppy, moderate sea, calm in evening.
12	13 09 N	309 24	55	257	20	Cloudy, chiefly on horizons. Light ENE airs to light ENE breeze. Moderate sea.
13	13 17 N	307 39	102	305	18	Cloudy, chiefly on horizons. Gentle E breeze. Moderate sea.
14	13 02 N	305 40	117	319	3	Cloudy, chiefly on horizons. Gentle SE breeze. Moderate sea.
15	12 54 N	303 43	115	286	12	Cloudy, chiefly on horizons. Gentle ESE breeze. Moderate sea.
16	13 01 N	301 31	128	329	11	Cloudy, chiefly on horizons. Gentle ExS breeze. Moderate sea. Sighted island at 16h 30m.
17	Carlisle Bay, Barbados			....	....	Partly cloudy. Gentle ExS breeze. Moderate sea. At anchor in Carlisle Bay at 08h 35m.

Barbados, B.W.I. to Balboa, Canal Zone

Total distance, 1361 miles; time of passage, 9.7 days; average day's run, 140.3 miles

Date	Noon position		Day's run	Current		Remarks
	Latitude	Longitude east		Dir.	Am't.	
1928	° ′	° ′	miles	°	miles	
Oct. 1	Barbados		....	....	....	Left anchorage at 11h 30m. Partly cloudy. Moderate sea and gentle NExE breeze.
2	14 41 N	298 37	141	245	17	Near the islands of St. Lucia and Martinique during morning. Cloudy, chiefly on horizons. Moderate sea and moderate to light NE breeze. Lightning in east.
3	14 46 N	296 24	129	277	22	Cloudy in morning, overcast in afternoon, with heavy shower in mid-afternoon. Lightning from NE to NW all day. Moderate to smooth sea. Gentle to moderate NNE to ExS breeze.
4	15 01 N	293 53	147	339	15	Cloudy in morning with lightning in SW in early hours. Overcast and squally during midday, clearing somewhat in afternoon. Moderate sea and moderate to light E breeze.
5	15 19 N	291 47	124	321	18	Partly cloudy. Lightning in NW and N morning and evening. Moderate sea and moderate easterly breeze.
6	15 10 N	288 45	176	303	16	Cloudy during day, clearing in evening. Lightning in NW in early morning. Moderate sea and moderate ESE breeze.
7	14 27 N	285 53	171	277	14	Cloudy, chiefly on horizons. Moderate sea and moderate E breeze.
8	13 34 N	283 31	147	306	37	Partly cloudy in morning. Overcast with rain in mid-afternoon, clearing in evening. Hazy in evening and lightning in S. Moderate sea and moderate to fresh ESE breeze.
9	11 23 N	281 29	177	317	22	Cloudy and hazy in morning. Overcast with rain, thunder and lightning in afternoon. Lightning in evening. Moderate sea and moderate to gentle easterly breeze. Hazy in evening.
10	10 15 N	280 46	81	36	18	Cloudy, with rain squalls, in morning. Cloudy in afternoon and evening. Lightning in SW in evening. Light easterly to SW breezes. Moderate to smooth sea.
11	Colon and Balboa		68	....	....	At anchor in Colon breakwater at 04h 00m. Cloudy all day. Light SxE and S breeze up to 04h 00m. Left Colon anchorage at 11h 00m with tug and docked at Balboa wharf at 19h 30m.

Balboa, Canal Zone to Easter Island

Total distance, 4788 miles; time of passage, 41.9; average day's run, 114.3 miles

Date	Latitude	Longitude east	Day's run	Dir.	Am't.	Remarks
1928	° ′	° ′	miles	°	miles	
Oct. 25	Balboa		....	....	....	Left dock at 10h 40m under tow. Ran 10 miles to Taboguilla Light abeam, at 12h 27m. Then took departure. Cloudy and hazy. Moderate sea and moderate NW breeze. Lightning in NW in late evening.
26	6 32 N	279 54	152	222	30	Cloudy in early morning. Overcast after 06h 00m, and all day, with rain squalls. Clear in evening. Moderate NW breeze changing to calm and, in evening to light SE and SW airs and breezes. Moderate to smooth sea.
27	5 44 N	280 06	49	115	3	Cloudy to overcast all day, with occasional short rain squalls. Clearing in evening. Lightning and thunder in east during morning. Gentle to moderate westerly breeze. Moderate sea.
28	4 15 N	280 21	90	86	13	Cloudy to overcast all day, with rain squalls and drizzling rain. Lightning and thunder in morning. Moderate to choppy sea. Variable moderate to light breezes, changing to calm in evening.
29	4 08 N	280 07	15	98	9	Cloudy, chiefly on horizons. Light to moderate southwesterly breezes. Moderate sea. Rain squalls from 16h 45m to 19h 00m.
30	2 53 N	279 52	76	94	16	Cloudy to overcast with occasional rain squalls after 04h 00m, and all day and evening. Moderate SW breeze. Moderate to choppy sea.
31	4 32 N	278 12	140	50	26	Cloudy, with frequent rain squalls throughout 24 hours. Fresh to moderate SW breeze. Choppy to moderate sea. Malpelo Island abeam at 07h 02m.
Nov. 1	6 03 N	277 01	116	76	13	Cloudy, with rain squalls all day. Clearing in evening. Gentle to moderate SW breeze. Moderate sea.
2	4 38 N	277 43	94	128	23	Overcast, with frequent rain squalls throughout 24 hours. Fresh SW breeze changing to light W and SW in evening. Choppy to moderate sea.
3	3 41 N	278 31	75	104	21	Cloudy to overcast. Squally. Rain squalls during morning. Moderate to fresh SW breeze. Moderate to choppy sea. Malpelo Island sighted at daybreak.
4	2 27 N	278 58	77	78	15	Overcast to cloudy. Moderate to gentle SSW to SWxW breezes. Moderate to choppy sea.
5	1 35 N	279 12	54	78	12	Overcast in early morning, clearing somewhat during day. Gentle to light SSW to W breeze. Moderate sea.
6	0 46 N	278 48	55	8	5	Overcast and hazy in early morning. Cloudy, chiefly on horizons, during day. Calm until 10h 00m, then gentle southwesterly breeze. Smooth to moderate sea.
7	0 27 N	277 57	89	192	9	Hazy in early morning. Cloudy until evening, then overcast and

Date	Noon position		Day's run	Current		Remarks
	Latitude	Longitude east		Dir.	Am't.	
1928	° ′	° ′	miles	°	miles	
Nov. 7						drizzling. Moderate southwesterly breeze. Moderate sea.
8	1 29 S	277 37	66	247	11	Overcast morning and evening; cloudy during day. Moderate SSW to light S breeze. Choppy to moderate sea.
9	1 19 S	275 05	152	262	16	Overcast in morning, otherwise cloudy chiefly on horizons. Gentle S breeze. Moderate to smooth sea.
10	1 39 S	272 55	131	253	55	Cloudy. Light to moderate S to SxE breeze. Smooth sea.
11	1 53 S	270 55	121	237	34	Cloudy, chiefly on horizons. Gentle to moderate S breeze. Moderate sea. Sighted Galapagos Islands in early p.m.
12	1 16 S	268 41	138	257	28	In vicinity of Galapagos Islands all day. Cloudy, chiefly on horizons. Light to moderate S to SE breeze. Smooth to moderate sea.
13	1 31 S	266 46	116	287	34	Overcast all day, hazy in evening. Gentle to light southeasterly breeze. Moderate to smooth sea. SE swells.
14	1 46 S	265 41	67	287	29	Overcast in early morning, clearing during day, cloudless in evening. Calm, to gentle SSE breeze. Smooth to moderate sea. SE swells.
15	2 30 S	264 15	96	269	12	Overcast in early morning, clearing overhead during the day. Gentle SSE to moderate SE breeze. Smooth to moderate sea.
16	3 04 S	261 44	154	276	10	Drizzling rain at 04h 00m. Cloudy to overcast all day and evening. Gentle to light SExS breeze. Moderate sea. SE swells.
17	3 15 S	260 07	98	280	17	Clear between 04h 00m and 08h 00m, otherwise cloudy. Light to moderate southeasterly breeze. Moderate sea. An unusual meteor appeared in ENE at 04h 45m, stopped at 35 altitude, and faded away.
18	4 01 S	257 20	173	293	22	Clear in very early morning, otherwise cloudy. Moderate to gentle SExS breeze. Moderate sea. SE swells.
19	4 35 S	254 51	152	308	30	Cloudy to overcast in very early morning; thereafter cloudy on horizons. Moderate to fresh SE to ESE breeze. Moderate sea. SE swells.
20	6 57 S	253 08	176	248	18	Clear, changing to cloudy on horizons. Moderate ESE to ExS breeze. Moderate sea.
21	9 14 S	251 34	165	250	15	Cloudy, chiefly on horizons. Moderate to fresh ExS to ESE breeze. Moderate sea.
22	11 57 S	249 45	195	261	14	Cloudy, chiefly on horizons. Fresh ESE breeze. Moderate sea.
23	14 12 S	248 04	167	256	16	Cloudy. Squally in afternoon and evening. Moderate ESE breeze. Moderate sea.
24	16 44 S	246 57	165	259	10	Cloudy and squally all day, with drizzling rain at 19h 00m. Fresh to moderate E to ESE breeze. Choppy sea.
25	19 14 S	245 52	162	252	10	Cloudy, chiefly on horizons. Fresh to moderate easterly breeze. Choppy to moderate sea. Easterly swells.
26	21 42 S	245 34	149	247	14	Cloudy, chiefly on horizons. Moderate to gentle easterly breeze. Moderate sea. Easterly swells.
27	23 20 S	245 13	100	258	10	Squally in early morning, with rain at 01h 00m. Clearing to cloudless in afternoon. Gentle easterly breeze. Moderate sea with easterly swells until noon, then SW and southerly swells.
28	24 48 S	244 35	94	282	15	Cloudy. Gentle to moderate easterly breeze. Moderate sea. Southerly swells.
29	26 36 S	244 40	108	261	16	Cloudy and squally in very early morning; rain at 02h 30m. Cloudy on horizons during day, drizzling rain in late evening. Moderate to gentle ENE breeze. Moderate sea, southerly swells.
30	28 04 S	244 51	89	247	18	Cloudy to overcast with rain squalls during morning, then cloudy to clear. Light to gentle northeasterly breeze. Moderate to smooth sea.
Dec. 1	29 12 S	245 13	70	156	6	Cloudy to clear. Light to gentle northeasterly breeze. Smooth sea.
2	30 34 S	245 44	86	162	7	Cloudy, chiefly on horizons. Light to gentle northeasterly breeze. Smooth sea. Southerly swells.
3	31 32 S	247 16	97	215	6	Overcast in mid-afternoon, otherwise cloudy. Gentle to moderate N to NW breeze. Moderate to smooth sea. Southerly swells.
4	31 23 S	249 56	137	139	16	Cloudy, chiefly on horizons. Squally in late evening. Moderate to fresh NW to WxN breeze. Moderate to choppy sea.
5	28 54 S	251 19	165	76	20	Overcast, with rain squalls in very early morning, then cloudy. Fresh to moderate W to SW breeze. Moderate sea.
6	Easter Island		117	....	....	Sighted Easter Island at 03h 40m. Cloudy. Moderate to light southwesterly breeze. Moderate sea. At anchor in Cook's Bay at 08h 55m.

Easter Island to Callao, Peru

Total distance, 3334 miles; time of passage, 32.9; average day's run, 101.3 miles

Date	Latitude	Longitude east	Day's run	Dir.	Am't.	Remarks
1928	° ′	° ′	miles	°	miles	
Dec. 12	Easter Island		....	....	....	Ran 10 miles from anchorage in Cook's Bay, then took departure off Needle and Flat Rocks at 17h 06m. Cloudy. Gentle E to NExE breeze. Moderate sea.

Date	Noon position		Day's run	Current		Remarks
	Lati- tude	Longi- tude east		Dir.	Am't.	
1928	° ′	° ′	miles	°	miles	
Dec. 13	28 10 S	250 49	71	....	....	Hazy morning and evening. Cloudy, chiefly on horizons. Light NE to E breezes. Smooth sea. Northeasterly swells, in morning, changing to southwesterly in afternoon and evening. Squally in evening, with rain at 20h 30m.
14	29 22 S	251 07	73	193	21	Clear overhead in early morning, thereafter cloudy to overcast, with occasional rain squalls. Light to gentle E to NE breezes until mid-afternoon, then moderate gale. Smooth to moderate to rough sea. Northeasterly swells.
15	31 08 S	250 29	112	265	17	Cloudy to overcast throughout, with frequent rain squalls. Moderate E gale to strong E breeze, changing in afternoon to fresh southeasterly breeze. Rough to choppy sea.
16	32 02 S	249 06	89	259	8	Cloudy, chiefly on horizons. Moderate to fresh to light southeasterly breezes. Choppy sea. Southeasterly swells.
17	31 45 S	250 35	78	23	12	Cloudy, chiefly on horizons, until evening; then clear. Light to moderate SE to E breezes until early evening, then calm. Moderate to smooth sea. Southeasterly swells.
18	31 53 S	251 02	25	200	10	Cloudless until noon, then cloudy on horizons. Calm to light northerly airs until mid-morning, thereafter moderate northerly breeze. Smooth to moderate sea. Easterly swells in morning.
19	32 27 S	252 37	87	154	8	Cloudy, chiefly on horizons, until evening, then overcast, with drizzling showers. Light to gentle northerly breeze until evening, then moderate northeasterly breeze. Smooth sea until evening, then moderate. Southerly swells.
20	34 03 S	253 18	102	105	13	Cloudy, chiefly on horizons. Hazy in afternoon. Moderate to gentle northeasterly breeze. Moderate sea.
21	35 17 S	254 37	98	218	11	Cloudy, chiefly on horizons, and hazy. Squally in evening. Heavy dew early morning and late evening. Moderate northeasterly breeze. Moderate sea. Southerly and westerly swells.
22	36 51 S	255 55	113	241	9	Overcast and foggy except in early morning and late evening; then cloudy and hazy. Moderate NExN and NE breeze. Moderate sea. Southerly swells.
23	38 40 S	257 06	122	204	22	Overcast to cloudy. Hazy. Moderate northeasterly breeze. Moderate sea.
24	39 54 S	258 59	114	186	17	Cloudy and hazy until noon, thereafter overcast and hazy. Moderate NNE to moderate and gentle N breeze. Moderate sea.
25	40 19 S	261 02	97	166	12	Cloudless in afternoon, otherwise cloudy on horizons. Gentle N to NNW breeze. Moderate sea. Heavy dew in late evening.
26	40 26 S	262 30	68	142	12	A few clouds on horizons, otherwise clear. Calm during morning, otherwise light N to NW airs and breezes. Smooth sea.
27	39 54 S	263 46	66	109	11	Cloudy, chiefly on horizons. Gentle to moderate northwesterly breeze. Smooth to moderate sea. Heavy dew in very early morning.
28	38 26 S	265 52	131	140	12	Cloudy and hazy in morning; overcast and hazy in afternoon and evening, with occasional showers. Moderate westerly breeze until late evening; then light SW breeze changing to calm. Smooth sea.
29	36 38 S	266 55	119	359	10	Overcast and rain in very early morning; calm. Thereafter cloudy, chiefly on horizons, with moderate SE to ESE breeze. Moderate sea.
30	34 32 S	268 10	140	283	13	Cloudy, chiefly on horizons. Moderate ESE to E breezes. Moderate sea. Rain 13h - 14h.
31	32 30 S	269 59	152	265	4	Cloudy in morning; cloudy to overcast thereafter. Moderate southeasterly breeze in morning; calm to light variable airs thereafter. Moderate to smooth sea. SE to SW swells.
1929						
Jan. 1	32 10 S	270 56	52	288	11	Cloudy, chiefly on horizons. Gentle to light SE breeze in early morning, otherwise calm. Smooth sea. Small easterly swells in morning.
2	31 54 S	271 10	21	....	....*	Cloudy, chiefly on horizons. Light southerly airs in morning, changing to northerly in afternoon. Smooth sea.
3	31 55 S	271 45	30	....	....*	Calm until midday. Light northerly airs thereafter. Cloudy, chiefly on horizons. Smooth sea.
4	31 45 S	272 45	53	....	....*	Overcast to cloudy until midday, thereafter clear or only cloudy on horizons. Light northwesterly to southwesterly airs and breezes. Smooth sea.
5	31 02 S	273 25	54	....	....*	Cloudy, chiefly on horizons, until late evening, then rain squalls. Light southwesterly airs in morning, changing to moderate southeasterly in afternoon. Smooth to moderate sea.
6	28 51 S	274 37	146	319	6	Clouds, chiefly on horizons. Moderate to fresh southeasterly breeze. Moderate sea. Overcast and rain squalls in late evening.
7	26 57 S	276 04	137	264	14	Overcast, with squall conditions. Drizzling rain and rain squalls in afternoon and evening. Fresh ESE to SE breeze. Moderate and choppy sea.
8	24 58 S	277 45	150	324	8	Overcast in morning, clear to cloudy in afternoon; overcast in evening. Moderate SE breeze. Moderate sea.

Date	Noon position: Latitude	Noon position: Longitude east	Day's run	Current: Dir.	Current: Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Jan. 9	23 06 S	278 45	125	308	12	Overcast. Moderate to gentle SE breeze. Moderate sea.
10	21 27 S	279 33	108	248	13	Overcast, with occasional small breaks in clouds. Moderate to fresh SE breeze. Moderate sea.
11	19 07 S	280 41	152	·273	16	Overcast, with occasional small breaks. Moderate to fresh SE to ESE breeze. Moderate sea.
12	16 42 S	281 22	150	298	13	Overcast in morning, cloudy in afternoon. Moderate ESE to SE breeze. Moderate sea.
13	14 06 S	282 08	162	315	12	Overcast in early morning, then clearing to clouds on horizons in afternoon. Moderate southeasterly breeze and moderate sea.
14	12 16 S	282 40	114	274	12	Heavy dew in early morning. Cloudy to clear to overcast during day. Moderate to smooth sea. Gentle southeasterly breeze, changing through light E airs, to calm.
14	Callao		23	....	....	At anchor in Callao harbor at 15h 22m.

*Current data unreliable, as ship's speed insufficient to register on log.

Callao, Peru to Papeete, Tahiti

Total distance, 4470 miles; time of passage, 35.8; average day's run, 124.9 miles

Date	Noon position: Latitude	Noon position: Longitude east	Day's run	Current: Dir.	Current: Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Feb. 5	Callao		....	....	....	Left anchorage in Callao harbor at 15h 20m. Ran 7 miles to San Lorenzo Island abeam at 16h 32m; then took departure. Cloudiness 7 to 8. Light southwesterly breeze. Smooth sea. Hazy.
6	11 54 S	281 20	89	....	....	Cloudiness 3 to 7, and hazy. Gentle S to SE breeze. Moderate sea. Light dew in early morning and late evening.
7	10 09 S	280 02	129	329	20	Cloudiness 1 to 5, chiefly on horizons. Gentle southeasterly breeze. Moderate sea. Hazy in afternoon.
8	9 57 S	277 45	136	336	15	Cloudiness 3 to 7, chiefly on horizons. Moderate S to SSE breeze. Moderate sea. Hazy in early morning.
9	10 26 S	275 45	122	310	8	Clouds 7 in morning. Clouds 1, on horizons, in afternoon. Moderate southeasterly breeze in morning to light southerly airs in afternoon. Moderate to smooth sea.
10	10 45 S	275 02	46	257	9	Cloudiness 1 to 8, chiefly on horizons. Light southerly airs in morning and evening; calm during day. Smooth sea.
11	10 39 S	274 06	56	279	8	Nearly overcast before 08h 00m, otherwise cloudiness 1 to 2 only on horizons. Gentle to light S to SE breezes. Smooth sea. Southerly swell.
12	11 00 S	272 32	94	330	9	Cloudiness 2 to 4, chiefly on horizons. Moderate S to SE breeze. Moderate sea.
13	12 33 S	270 18	161	302	9	Cloudy to overcast after early morning hours; a few clouds on horizons before 04h 00m. Moderate to fresh SE breeze. Moderate sea.
14	14 23 S	267 45	185	255	16	Partly cloudy, amount 2 to 5, except just before noon; then nearly overcast. Fresh to moderate SE breeze. Moderate sea.
15	15 49 S	265 06	175	287	12	Cloudy to overcast, amount 9 to 10, up to noon. Squally. Drizzling rain at 07h 00m. Clearing overhead after midday, clouds 2 to 5. Hazy. Moderate SE to E breeze. Moderate sea.
16	15 16 S	262 23	161	305	5	Cloudiness 3 to 8 in morning; 8 to 10 in afternoon and evening. Moderate ESE to ExS breezes. Moderate sea. Hazy.
17	14 46 S	259 14	186	273	7	Cloudiness 6 to 9 in morning; clearing somewhat in afternoon with cloudiness 2 to 5. Moderate to fresh easterly breeze. Moderate sea. Short drizzling rain at 05h 00m.
18	14 19 S	256 41	150	273	3	Cloudiness 1 to 7; hazy. Moderate E and ExS breeze. Moderate sea.
19	13 34 S	254 07	156	291	5	Cloudiness 2 to 3, on horizons. Moderate ExS and ESE breezes. Moderate sea.
20	13 00 S	251 51	137	283	6	Cloudiness 2 to 5, on horizons, until late evening, then clouding over to amount 9. Moderate ESE to gentle ExS breeze. Moderate sea.
21	12 31 S	249 53	119	124	3	Cloudiness 2 to 7, chiefly on horizons. Gentle to moderate easterly breeze. Moderate sea.
22	12 36 S	247 40	130	196	3	Cloudiness 3 to 6, chiefly on horizons. Moderate easterly breeze. Moderate sea.
23	12 31 S	244 50	166	357	4	Cloudiness 5 to 6, chiefly on horizons. Moderate easterly breeze. Moderate sea.
24	12 41 S	242 27	140	261	6	Cloudy and partly cloudy; amounts 1 to 8. Moderate to gentle E to NE breezes. Moderate sea.
25	12 46 S	240 36	109	122	4	Cloudiness 2 to 5, chiefly on horizons, until evening, then almost overcast. Gentle to moderate ENE to E breezes. Moderate sea.
26	13 03 S	238 42	114	319	3	Cloudiness 9 to 4. Gentle to moderate easterly breeze. Moderate sea. Easterly swell.
27	13 28 S	235 50	169	236	8	Drizzling rain and a rain squall between 01h 00m and 03h 00m. Cloudiness thereafter 1 to 5, chiefly on horizons. Moderate sea. Fresh to moderate ENE to E breezes.

Callao, Peru to Papeete, Tahiti--Concluded

Date	Noon position		Day's run	Current		Remarks
	Latitude	Longitude east		Dir.	Am't.	
1929	° ′	° ′	miles	°	miles	
Feb. 28	14 52 S	233 50	143	282	10	Cloudiness 3 to 9. Moderate easterly breeze. Moderate sea.
Mar. 1	16 33 S	231 56	149	303	5	Cloudiness 1 to 4, chiefly on horizons. Moderate to gentle easterly breeze. Moderate sea.
2	17 01 S	230 13	102	108	3	Clear to cloudiness 1 to 4. Gentle easterly breeze. Moderate sea.
3	17 07 S	228 18	111	141	5	Cloudiness 1 to 2, on horizons. Gentle easterly breeze. Moderate sea. Easterly swells.
4	17 12 S	226 39	94	122	8	Cloudiness 1 to 5, chiefly on horizons. Gentle E to SE breezes. Moderate sea.
5	17 05 S	224 37	117	335	4	Cloudiness 2 to 4, chiefly on horizons. Gentle ESE to ENE breezes. Moderate sea. Northeasterly swells.
6	17 13 S	223 22	72	199	2	Cloudiness 1 to 4, chiefly on horizons, except in early evening, then cloudiness 9. Light northeasterly breezes to airs in morning; calm in afternoon. Started engine at noon. Smooth sea. Rain squall at 01h 30m.
7	17 24 S	221 07	129	195	5	Sighted Tatakoto Island at 05h 30m. Cloudiness 2 to 6, chiefly on horizons. Calm until late afternoon, then light SSE airs. Smooth sea. Hazy. Engine running.
8	17 48 S	219 11	113	....	....	Sighted Amanu Island at 05h 15m. Cloudiness 1 to 6, chiefly on horizons. Light SE airs in morning. Light ESE breeze in afternoon. Smooth sea. Ship hove to from 08h 30m until 16h 00m while scientific staff ashore. Running with engine, until 17h 10m.
9	17 36 S	217 58	71	....	....	Cloudiness 2 to 5 until noon, 8 to 9 after noon. Gentle to light easterly breezes. Smooth sea. Started engine at 20h 00m. Hazy in evening.
10	18 02 S	215 55	119	167	4	Cloudiness 1 to 10; overcast and squally in afternoon. Rain from 18h 00m to 20h 00m. Variable NE to SE breezes. Smooth to moderate sea. Stopped engine at 07h 10m.
11	18 05 S	214 20	90	189	1	Cloudiness 8 to 10; squally. Rain squalls in mid-afternoon. Gentle northwesterly breezes until 20h 00m, then calm. Running engine after 15h 47m. Smooth to moderate sea.
12	17 51 S	211 59	135	270	1	Cloudiness 6 to 10; squally. Lightning in SE in early morning. Light showers before 05h 00m. Mehetia Island abeam and distant 2 miles at noon. Gentle northwesterly breezes. Smooth to moderate sea. Heavy rain squalls during evening. Engine running.
13	Papeete		95	....	....	Cloudiness 10; squally. Light NW airs to calm to light E airs. Smooth sea. At anchor in Papeete harbor at 09h 55m.

Note: cloud amounts expressed in scale from 0 for cloudless to 10 for overcast.

Papeete, Tahiti to Pago Pago, Samoa

Total distance, 1274 miles; time of passage, 12.2; average day's run, 104.4 miles

Date	Latitude	Longitude east	Day's run	Dir.	Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Mar. 20	Papeete		....	....	....	Left anchorage in Papeete harbor under own power at 03h 35m. Ran 3 miles, then took departure at 04h 33m. Cloudiness 8 and 9. Rain squalls in evening. Moderate to gentle easterly breeze. Moderate sea. Southeasterly swells.
21	16 46 S	209 16	78	....	....	Cloudiness 2 in very early morning; thereafter 6 to 9, with rain squalls in late afternoon. Gentle to light northerly and westerly breezes. Southeasterly swells. Started engine at 05h 55m, stopped at 08h 00m.
22	17 36 S	208 15	77	136	6	Cloudiness 7 to 9 with rain squalls during morning, otherwise cloudiness 2 to 4, chiefly on horizons. Moderate northwesterly breezes in morning; light westerly airs in afternoon. Moderate, choppy sea. Started engine at 20h 00m.
23	17 10 S	207 19	60	26	2	Cloudiness 1 to 3, on horizons. Light westerly to easterly airs, to calm. Stopped engine at 08h 00m, started at 12h 37m, stopped at 15h 45m. Smooth sea.
24	16 54 S	206 20	59	329	7	Cloudiness 2 to 5 before noon, 5 to 8 after noon. Rain squalls in late evening. Light, to gentle, to moderate easterly breeze. Smooth sea until evening, then moderate.
25	16 32 S	203 59	137	252	7	Cloudiness 7 to 10 with lightning in NE and NW in early morning and in evening. Moderate to gentle easterly breeze. Rain squalls in evening. Moderate sea.
26	16 08 S	201 38	138	157	9	Cloudiness 5 to 9, with rain squalls at intervals throughout 24 hours. Moderate E and ExN breeze. Moderate sea. Thunder in morning.
27	15 42 S	199 26	129	240	2	Cloudiness 5 to 10, with rain squalls in very early hours and threatening all day. Variable light to moderate E to N breezes. Moderate to broken sea.
28	15 32 S	198 00	84	180	7	Overcast in morning, with rain squalls very early. Cloudiness 5 to 7 in afternoon, 4 to 2 in evening. Gentle to light E breezes until evening, then calm. Moderate to smooth sea. Started engine at 21h 12m.

Papeete, Tahiti to Pago Pago, Samoa--Concluded

Date	Noon position: Latitude	Noon position: Longitude east	Day's run	Current: Dir.	Current: Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Mar. 29	15 16 S	196 40	79	270	4	Cloudiness 2 to 4, chiefly on horizons. Calm to light variable airs. Smooth sea. Engine running,
30	14 42 S	194 20	139	341	6	Cloudiness 3 to 6, with rain squalls in afternoon. Calm, or light variable airs. Smooth sea. Engine running.
31	14 41 S	192 07	129	294	2	Cloudiness 5 to 8 until late evening, then cloudiness 2. Rain squalls in early evening. Calm in early morning, changing to light and gentle northerly breezes in forenoon and, in afternoon, to light westerly breezes. Smooth sea. Engine running.
Apr. 1	14 26 S	189 58	125	233	8	Sighted Manua Islands at 03h 00m. Cloudiness 3 to 6. Light to gentle northwesterly breezes. Smooth sea. Engine running.
1	Pago Pago		40	....	....	At anchor in Pago Pago harbor at 19h 33m.

Pago Pago, Samoa to Apia, Western Samoa

Date	Latitude	Longitude east	Day's run	Dir.	Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Apr. 5	Pago Pago		....	....	....	Left Pago Pago harbor under own power at 14h 10m. Light SW to W breezes until evening, then calm. Moderate to smooth sea. Cloudiness 3 to 4, chiefly on horizons. Engine running.
6	Apia		80	....	....	Cloudiness 3. Hazy. Light W airs, to calm. Smooth sea. Engine running. At anchor in Apia harbor at 08h 15m.

Apia, Western Samoa to Guam, Marianas Islands

Total distance, 3914 miles; time of passage, 28.8; average day's run, 135.9 miles

Date	Latitude	Longitude east	Day's run	Dir.	Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Apr. 20	Apia		....	....	....	Let go moorings in Apia harbor at 11h 25m. Took departure at 11h 35m. Shut down engine at 13h 13m. Cloudiness 6 to 4. Light northwesterly breeze in early afternoon, changing through calm to light northeasterly airs and breezes in late afternoon and evening. Smooth sea.
21	13 07 S	188 12	42	312	8	Cloudiness 4 to 6. Gentle easterly breeze. Smooth to moderate sea. Found two stowaways on board at 08h 00m. Returned to Apia and transferred stowaways to harbor tug at 18h 45m.
22	12 44 S	188 23	25	260	9	Cloudiness 3 in very early morning on horizons, increasing to 8 by noon. Overcast in afternoon and until late evening. Gentle to moderate easterly breeze until mid-afternoon, then varying between moderate breeze and calm. Rain squalls in afternoon and evening Hazy in late evening.
23	11 20 S	188 24	83	254	10	Cloudiness 5 to 7 in morning, 4 in afternoon, chiefly on horizons. Moderate to fresh E to SE breezes. Moderate sea.
24	8 40 S	188 57	164	321	21	Cloudiness 4 to 7 in morning, 2 to 5 in afternoon. Easterly breeze, moderate in morning, gentle to light in afternoon. Moderate sea until late evening, then smooth with easterly swells. Rain squalls at 11h 30m and 14h 00m.
25	7 39 S	188 11	76	272	16	Cloudiness 8 to 9 in morning, with occasional rain squalls before 06h 30m. Cloudiness 6 to 4 in afternoon and 10 in late evening, with rain squall at 21h 45m. Light northerly airs to calm in morning; light NE breeze in afternoon. Smooth sea. Easterly swells. Hazy and misty during day. Engine running.
26	6 44 S	187 35	65	244	17	Cloudiness 8 and 9 in morning and evening, 4 to 6 during day. Light northerly airs to calm. Smooth sea. Easterly swells. Squally in evening. Engine running.
27	5 08 S	187 37	96	194	11	Cloudiness 3 in early morning, 5 and 6 during day, 8 in evening. Calm in morning, light NW airs and breezes in afternoon, calm in evening. Smooth sea. Squally and hazy in mid-afternoon. Engine running
28	3 47 S	187 19	83	260	14	Cloudless and calm until 05h 00m, thereafter cloudiness 4 and 3 and northeasterly breeze, increasing through day from light, in early morning, to moderate in evening. Smooth to moderate sea. Engine running.
29	1 46 S	186 31	130	272	16	Cloudiness 3 and 4, only on horizons, until noon, increasing after noon to 9 in late evening. Gentle to moderate E to NE breezes. Moderate sea. Rain squalls at 22h 50m and 23h 40m.
30	0 22 N	185 58	135	283	12	Cloudiness 4 in early morning, decreasing to cloudless in mid-afternoon, then increasing to overcast in late evening. Fresh to moderate E to NE breezes. Moderate sea.
May 1	2 30 N	184 54	144	336	10	Cloudiness 5 to 8 in morning, 4 thereafter. Gentle to moderate to fresh northeasterly breezes. Moderate to choppy sea. Rain squalls at intervals from early morning to late evening.
2	4 22 N	183 37	136	166	6	Cloudiness 4 in early morning, thereafter 8 to 10, with rain squalls during morning and heavy showers between 16h 00m and 18h 30m. Hazy all day. Fresh to moderate northeasterly breezes. Choppy sea.

Apia, Western Samoa to Guam, Marianas Islands--Concluded

Date	Noon position		Day's run	Current		Remarks
	Latitude	Longitude east		Dir.	Am't.	
1929	° ′	° ′	miles	°	miles	
May 3	6 29 N	182 16	149	231	4	Cloudiness 8 to 10 until late evening, then 6. Squally in morning. Rain squalls at 13h 30m, 15h 32m, 20h 45m. Fresh to moderate NE breeze. Moderate and choppy sea.
4	8 10 N	181 07	122	258	10	Cloudiness very variable, ranging in amount from 4 to 9. Rain squalls at 14h 15m, 15h 00m, and 18h 15m. Moderate to fresh northeasterly breeze. Moderate sea. Hazy.
5	10 47 N	179 26	185	259	20	Cloudiness 6 in early morning, thereafter 4. Squall conditions all day, with rain squall at 16h 50m. Fresh to strong northeasterly breeze. Choppy sea.
6	....	....	....	....	....	Omitted, because the 180th meridian was crossed.
7	13 31 N	177 20	205	269	26	Cloudiness 3 to 6. Light rain at 04h 00m. Strong ENE breeze in early morning, changing during day through fresh to moderate in evening. Squally in afternoon. Hazy in evening. Choppy sea.
8	15 23 N	174 43	194	253	12	Cloudiness 3 to 4, chiefly on horizons, until noon, 9 in early afternoon, and 4 to 5 thereafter. Rainsquall at 22h 10m. Moderate to fresh NE to ENE breezes. Moderate sea.
9	16 28 N	171 49	179	232	10	Cloudiness 5 to 3, chiefly on horizons. Fresh NExE and ENE breezes. Choppy, moderate sea. Squally in evening, with drizzling rain at 22h 10m. Hazy. NE swells.
10	18 29 N	169 00	202	215	13	Cloudiness 10 in early morning, clearing to 3 by mid-morning, clouding over to 8 before noon and clearing to 3 in late afternoon. Squally in early morning. Fresh to moderate NExE and ENE breeze. Choppy to moderate sea. Hazy in afternoon.
11	19 19 N	166 24	156	218	7	Cloudiness 2 to 4 in morning, 7 to 2 after noon, chiefly on horizons. Moderate ENE breeze. Moderate sea. Sighted Wake Island at 08h 00m. Hazy in early morning.
12	20 17 N	163 40	165	348	3	Cloudiness 3 to 10 up to noon and 6 to 3 thereafter. Moderate to gentle ENE and NExE breezes. Moderate sea. Light rain at 03h 05m and squally during morning.
13	20 13 N	161 08	142	244	12	Cloudiness 2 to 7 in morning and 4 to 2 in afternoon, chiefly on horizons. Moderate northeasterly breeze. Moderate sea.
14	19 30 N	158 27	158	292	12	Cloudiness 3 to 5, chiefly on horizons. Gentle to fresh ExS breeze. Moderate sea.
15	18 39 N	156 02	145	313	12	Cloudiness 4 to 9 during morning, 3 to 5 after noon, chiefly on horizons. Gentle to moderate ExS and SExS breezes. Moderate sea. Horizons hazy in early morning. Lightning in S in early morning. Rain squall at 10h 30m.
16	17 28 N	153 25	165	316	20	Cloudiness 1 in early morning, thereafter 5 to 6. Moderate ExS to SExS breezes. Moderate sea. Heavy rain at 23h 20m.
17	16 08 N	150 52	166	297	14	Cloudiness 5 to 9 except for few hours in mid-afternoon, when practically cloudless. Squally in very early morning. Moderate to fresh ExS to SE breezes. Moderate sea.
18	14 54 N	148 12	171	328	23	Cloudiness 2 in early morning; increasing amount of thin clouds to 9 by noon; thereafter cloudiness 8 to 10. Moderate ExS and E breezes. Moderate sea.
19	14 02 N	145 56	142	276	8	Cloudiness, chiefly on horizons, 3 to 8 in morning, 3 to 5 after noon. Moderate to gentle E breezes. Moderate sea. Sighted Rota Island at 09h 00m and Guam at 17h 00m. Hazy in morning and evening.
20	Port Apra, Guam		89	....	....	Cloudiness 3 in early morning. Light southeasterly breeze. Smooth sea. Started engine at 05h 50m outside Port Apra. Pilot aboard at 06h 00m. Moored in Port Apra at 08h 00m.

Port Apra, Guam to Yokohama, Japan

Total distance, 1447 miles; time of passage, 13.2; average day's run, 109.6 miles

Date	Latitude	Longitude east	Day's run	Dir.	Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
May 25	Port Apra		....	....	....	Let go moorings at 13h 45m, ran one mile under own power, and took departure at 14h 08m. Cloudiness 4 and 5, chiefly on horizons. Moderate ENE breeze. Moderate sea.
26	16 05 N	144 07	161	289	9	Cloudiness 2 to 5, chiefly on horizons, except in mid-afternoon, when cloudless. Moderate ENE to E breezes. Moderate sea. Rain at 01h 45m.
27	18 33 N	143 59	148	262	8	Cloudiness 6 to 1, chiefly on horizons. Moderate E breeze. Moderate sea. Drizzling rain at 04h 25m.
28	21 31 N	144 13	179	334	7	Cloudiness 1 to 5, chiefly on horizons. Moderate to gentle easterly breeze. Moderate to smooth sea.
29	23 26 N	144 05	115	323	10	Cloudiness 7 in very early morning, decreasing through day to 1 in late evening. Gentle to moderate E to SE breezes, until mid-afternoon, then southeasterly light breezes to light airs. Squally in early morning with rain at 00h 05m. Light dew in evening. Running with engine after 19h 23m.

Date	Noon position Lati-tude	Noon position Longi-tude east	Day's run	Current Dir.	Current Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
May 30	25 15 N	144 09	109	228	15	Cloudiness, chiefly on horizons, 4 to 6 before noon, 3 to 4 after noon. Calm in very early morning, then light to gentle southeasterly breezes. Squally in early morning. Hazy in morning and evening. Smooth sea. Stopped engine at 07h 05m.
31	26 24 N	144 25	71	152	14	Cloudiness 4 to 8 until mid-afternoon, thereafter 2 on horizons. Gentle S breeze decreasing in force to light airs in afternoon and evening. Smooth sea. Heavy dew in morning, light in evening. Engine started 18h 00m.
June 1	28 29 N	144 00	127	298	3	Cloudiness 6 to 10. Light southerly breezes in early morning, increasing in force to strong in late evening. Smooth sea in morning, changing through day to rough in late evening. Heavy dew in morning. Rain at 23h 45m. Engine stopped 06h 00m.
2	30 10 N	143 56	101	132	14	Overcast before noon, thereafter cloudiness 7 to 9. Hazy all day. Fresh SWxW breeze until mid-morning, changing to moderate westerly breeze and decreasing in force through afternoon to calm in late evening. Choppy, moderate sea. Started engine midnight.
3	31 03 N	144 18	57	63	18	Cloudiness 8 to 10 until late evening, then 6. Very hazy all day. Light westerly airs in early morning, increasing in force to moderate in evening. Choppy, moderate sea. Northwesterly swells in early morning. Started engine at 12h 10m. Stopped engine 08h 00m.
4	32 42 N	142 13	145	307	21	Cloudiness 8 to 10 until late evening, then 5. Moderate to fresh southwesterly breezes. Choppy, moderate sea. Hazy all day. Southwesterly and westerly swells. Stopped engine at 05h 38m. Started engine at 15h 00m.
5	33 57 N	141 12	91	30	15	Cloudiness 4 in very early morning, thereafter 8 to 10. Gentle to moderate W to SW breezes. Moderate sea. Hazy all day. Westerly and northerly swells. Sighted Miyake Island at 18h 30m. Saw reflected ray from Nojima Zaki Lighthouse (SE Japan) during evening. Stopped engine at 15h 55m. Drizzling rain after 23h 06m, with rapidly falling barometer. Started engine at 17h 20m.
6	34 52 N	140 39	61	44	38	Overcast in morning, with drizzling rain in early morning; cloudiness decreasing after noon to 3 in evening. Moderate southerly breezes in early morning increasing in force to fresh gale by midday and decreasing to moderate breeze in evening. Rough sea. Stopped engine at 02h 00m, started at 04h 45m, stopped at 09h 45m and hove to on southern edge of typhoon.
7	Yokohama		82	....	....	Overcast all day, and hazy. Gentle to fresh NE breeze after 01h 30m. Moderate sea. Got under way with sails at 01h 35m. Started engine at 10h 55m and ran in to Yokohama harbor. Anchored outside breakwater at 19h 45m.

Yokohama, Japan to San Francisco, U.S.A.

Total distance, 4839 miles; time of passage, 34.9; average day's run, 138.7 miles

Date	Lati-tude	Longi-tude east	Day's run	Dir.	Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
June 24	Yokohama		....	....	....	Took departure from Honmoku Buoy, Yokohama harbor, under own power, at noon and ran 33 miles to entrance to outer bay at 17h 50m. Overcast, hazy, rainsqualls. Gentle to moderate northeasterly breezes. Smooth to moderate sea. Easterly swells in late evening.
25	34 44 N	141 04	98	66	44	Overcast and drizzling in early hours, clearing to amount 7 by noon and to amount 4 by late evening. Hazy all day. Calm in early morning, changing to gentle easterly breezes before 06h 00m. Moderate sea.
26	36 00 N	142 05	91	47	42	Cloudiness 4 in early morning, increasing steadily to overcast by noon; thereafter overcast. Hazy throughout. Light ESE airs and breezes up to noon, thereafter light SSE breezes. Smooth sea. Heavy dew in morning, light dew in evening. Southeasterly swells.
27	36 41 N	143 38	85	33	9	Cloudiness 4 on horizons in early morning and late evening, otherwise overcast. Hazy throughout. Gentle to light SSE breezes during morning, changing through S to SSW by mid-afternoon. Light airs to calm after 15h 00m. Smooth sea. Swung ship for declination in afternoon.
28	36 46 N	145 23	85	237	4	Hazy throughout. Cloudiness 7 to 9 throughout. Heavy dew in early morning. Calm until 08h 00m, thereafter light easterly airs and breezes. Swung ship for horizontal intensity and inclination from 09h 00m to 19h 00m. Smooth sea.
29	37 45 N	145 27	59	294	18	Cloudiness 9 to 10 (overcast) throughout. Hazy after midday. Gentle easterly breezes until late afternoon; light airs to calm thereafter. Smooth sea. Started engine at 18h 57m.

Date	Noon position		Day's run	Current		Remarks
	Latitude	Longitude east		Dir.	Am't.	
1929	° ′	° ′	miles	°	miles	
June 30	38 06 N	147 00	76	98	9	Cloudiness 7 to 4 in morning; 7 to 10 thereafter. Hazy. Light southeasterly airs throughout, except for few hours gentle breeze in afternoon. Smooth to moderate sea. Southeasterly swells. Stopped engine at 12h 50m.
July 1	38 43 N	147 42	49	336	8	Cloudiness 2 to 6, chiefly on horizons. Slight haze in early morning. Light to gentle SE breezes. Moderate sea. Southeasterly swells in morning.
2	39 50 N	149 29	106	35	9	Cloudiness 9 in early morning, decreasing gradually to 3 in early evening, then increasing to 7 in late evening. Gentle to light southeasterly breezes. Moderate to smooth sea. Southeasterly swells in morning.
3	40 22 N	151 03	79	32	15	Cloudiness 7 to 9 during afternoon, otherwise overcast. Gentle southeasterly breezes. Smooth sea.
4	41 22 N	153 16	116	57	11	Overcast throughout. Misty and drizzling in evening. Gentle to moderate southeasterly breeze. Moderate sea.
5	42 35 N	155 33	126	309	9	Overcast throughout, with mist, fog, and drizzling rain. Moderate SExS breeze. Moderate sea.
6	43 45 N	158 12	135	355	7	Overcast throughout, with mist, fog, or drizzling rain. Gentle to moderate SSE breeze. Moderate sea.
7	45 30 N	159 40	122	14	9	Overcast throughout, with fog or drizzling rain. Gentle to moderate southerly breeze. Moderate sea.
8	46 56 N	162 58	161	35	9	Overcast throughout, with mist, fog, or drizzling rain. Moderate to gentle S and W breezes. Moderate sea.
9	47 02 N	166 34	148	153	8	Overcast throughout, with mist or fog. Moderate W breeze until evening, then light northwesterly breeze. Moderate sea.
10	46 43 N	169 27	120	185	8	Overcast throughout, with mist or haze. Moderate to gentle NNE breeze. Moderate sea. Northwesterly swells in evening.
11	46 00 N	171 41	103	235	10	Overcast throughout, with mist or fog. Moderate to gentle NNE to NE breezes. Moderate sea. Northwesterly swells in morning.
12	45 16 N	172 58	69	266	6	Overcast throughout, with thick fog. Gentle to light southeasterly breezes. Smooth sea. W and NW swells in morning, E to SE swells in afternoon.
13	46 22 N	174 08	82	5	9	Overcast throughout, with mist or thick fog. Light to gentle southeasterly breezes in morning, moderate to fresh southerly breeze after midday. Smooth to moderate and choppy sea. Rain during morning. Southeasterly swells in morning.
14	48 07 N	178 06	192	15	9	Overcast throughout, with mist, fog or rain. Fresh southerly breeze. Choppy sea.
14	49 14 N	183 20	218	18	13	Overcast throughout, with mist, thick fog, or rain. Strong to moderate SxW breezes. Choppy, rough sea.
15	50 32 N	187 18	172	63	7	Overcast throughout, with thick fog in morning; hazy thereafter. Fresh to strong SxE breeze. Moderate, choppy sea.
16	51 25 N	192 41	210	14	10	Overcast throughout; heavy mist in evening. Fresh to strong southerly breeze. Choppy sea.
17	52 22 N	198 14	214	26	8	Overcast throughout, with mist, fog, or haze. Strong SxE and S breeze. Choppy sea.
18	52 33 N	204 23	225	47	16	Overcast throughout, with thick fog or mist. Fresh S to SW breezes Choppy sea. Southwesterly swells.
19	51 57 N	209 35	195	116	7	Overcast throughout; drizzling rain in early morning, mist thereafter. Fresh SWxW breeze. Choppy sea. Southwesterly swells.
20	50 13 N	213 54	192	126	5	Overcast throughout; misty until evening, then drizzling rain. Fresh to strong SWxW and SW breeze. Choppy sea. Southwesterly swells.
21	47 59 N	217 17	189	299	13	Cloudiness 9 to 10 (overcast), misty and hazy. Strong SW to W breeze. Choppy sea. Westerly swell in afternoon.
22	45 58 N	220 15	171	311	14	Cloudiness 7 in morning, increasing to 10 (overcast) in evening. Rain in early morning and late evening. Moderate to fresh W to WSW breezes. Moderate sea.
23	44 16 N	222 25	137	295	10	Cloudiness 9 in early morning, decreasing to 4 by noon, remaining so until late evening, then increasing to 9. Drizzling rain at intervals up to 08h 00m, then hazy until noon. Clear after midday. Moderate WxS to WSW breezes. Moderate sea.
24	42 34 N	224 46	144	339	8	Overcast throughout, with rain at intervals throughout. Moderate to fresh SW to S breezes. Moderate sea.
25	40 39 N	227 39	173	283	11	Cloudiness 8 to 10 (overcast) in morning, overcast thereafter. Hazy during day. Drizzling rain and mist in evening. Fresh southerly winds to mid-day, moderate to gentle westerly thereafter. Moderate sea.
26	39 36 N	230 28	144	240	12	Cloudiness 7 just before midday, otherwise 9 to 10 (overcast). Drizzling rain and mist in early morning. Moderate to strong N breeze. Moderate to choppy sea. W swells in early morning.

Yokohama, Japan to San Francisco, U. S. A.--Concluded

Date	Noon position: Latitude	Noon position: Longitude east	Day's run	Current: Dir.	Current: Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
July 27	38 49 N	234 14	182	254	20	Cloudiness 6 to 9 until midday; overcast thereafter. Hazy in late evening. Strong NNW breeze in morning, decreasing in force through afternoon to light in evening. Choppy to moderate sea. Started engine at 21h 30m.
28	37 56 N	237 04	143	207	17	Overcast; haze and fog until noon. Light NNW airs to calm. Moderate to smooth sea. Heard Point Reyes fog signal at 08h 45m.
28	San Francisco		28	....	...	Entered San Francisco harbor at 16h 00m and dropped anchor at 16h 30m.

San Francisco, U. S. A. to Honolulu, T. H.

Total distance, 2186 miles; time of passage, 20.1 days; average day's run, 108.8 miles

Date	Noon position: Latitude	Noon position: Longitude east	Day's run	Current: Dir.	Current: Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Sep. 3	San Francisco		....	....	...	Took departure under own power from pier 16, San Francisco harbor at 10h 00m and streamed the log at 13h 45m, through the Golden Gate. Ran 12 miles to Bell No. 5 at 15h 18m, thence 64 miles to the noon position on Sep. 4. Smooth sea, easterly swells in the evening. Overcast and hazy all day. Calm to gentle breeze.
4	37 07 N	236 21	(76)	(330)	5	Smooth to moderate sea. NW swells. Light airs and light S breezes in forenoon and gentle W breezes in the afternoon and evening. Main engine stopped at 08h 00m, started at 13h 50m, and stopped again at 18h 10m.
5	35 30 N	235 02	116	294	23	Moderate sea all day with moderate NW breezes. Cloudiness 10 most of the day with a minimum of 5 at 16h 00m.
6	33 47 N	233 40	123	92	15	Moderate sea; gentle NW breezes. Light drizzle in morning and in late afternoon with the sky overcast much of the day.
7	32 25 N	232 08	112	155	12	Sea moderate in a.m. with NW swells, smooth thereafter. Light and gentle NW breezes. Sky overcast nearly all day.
8	31 36 N	231 13	68	121	8	Smooth sea; gentle NW breezes. Cloudiness 7 to 10. Started main engine at 12h 55m, stopped main engine at 20h 05m.
9	30 23 N	229 06	131	240	10	Sea smooth in morning with gentle NW breezes. Sea moderate with gentle to moderate NNE breezes in the afternoon. Sky partly cloudy.
10	29 19 N	227 27	107	70	11	Sea moderate with gentle to moderate NNE breezes. Sky partly cloudy.
11	28 12 N	225 40	114	198	1	Sea smooth with light to gentle N and NE breezes. Morning sky overcast, partly cloudy in afternoon.
12	27 44 N	224 33	66	234	4	Sea smooth. Light airs to light ExS breezes in morning; calm in afternoon. Sky overcast in morning, clear in afternoon. Main engine started at 11h 20m.
13	26 58 N	222 13	124	47	11	Sea smooth. Light SE airs. Sky clear in morning, partly clear in afternoon. Engine stopped 18h 45m.
14	26 40 N	220 52	75	280	13	Sea smooth. Light S breezes. Sky partly clear a little rain at 06h 30m. Main engine started 00h 45m. Main engine stopped at 04h 45m, started at 19h 15m, then stopped at 23h 08m.
15	26 27 N	219 24	80	351	12	Sea smooth. Light S airs to gentle S breezes. Sky partly cloudy. Main engine started 04h 40m and stopped 10h 00m.
16	26 13 N	217 56	80	49	15	Smooth sea. Gentle SE breezes. Sky partly clear in morning, and partly overcast in the afternoon. Main engine started at 18h 50m.
17	25 07 N	216 22	108	34	10	Smooth sea in morning with light SE breeze. Moderate sea in the afternoon and evening with moderate NE breezes. Sky clear all day with horizon partly cloudy. Sky overcast in evening, rain at midnight. Stopped engine at 06h 45m.
18	24 02 N	214 26	124	24	15	Moderate sea, moderate NExN breezes. Rain at 01h 20m. Mostly clear near midday with horizon cloudy and partly clear in afternoon. Sky clear, horizon cloudy in evening.
19	23 21 N	211 18	177	76	10	Moderate sea, moderate NExE breezes in forenoon. Sky mostly overcast during afternoon, squally near midnight.
20	22 51 N	208 37	151	98	8	Moderate sea, moderate ExNE breezes in forenoon, moderate ExN breezes in afternoon. Partly cloudy with overhead clear most of the day.
21	22 16 N	206 23	129	54	15	Moderate sea, moderate ENE breezes during first part of morning with gentle breezes ExNE and NExE during the rest of the day. Horizon partly cloudy in the early morning and late evening with sky about half overcast during the day.
22	21 44 N	204 20	119	23	14	Sea moderate. Gentle ESE breezes in morning and gentle ExS breezes in the evening. Few drops of rain in early morning with squalls. Sky partly cloudy during the day.
23	Honolulu		106	....	...	Started engine at 07h 50m. In harbor at 10h 00m.

Honolulu, T. H. to Pago Pago, Samoa

Total distance, 5,777 miles; time of passage, 47.2; average day's run, 122.2 miles

Date	Noon position		Day's run	Current		Remarks
	Lati-tude	Longi-tude east		Dir.	Am't.	
1929	° ′	° ′	miles	°	miles	
Oct. 2	Honolulu harbor					Left the dock at 10h 00m assisted by tug. Left tug at 10h 25m and ran 14 miles to bearings at noon. Moderate sea with fresh ENE breeze. Cloudiness 6 to 10 with rain squalls in the evening.
2	21 16 N	201 54	(14)	....	...	
3	23 32 N	200 28	157	174	12	Moderate sea, moderate to fresh ENE breezes in morning, fresh E breezes first part of the afternoon and moderate NExE breezes in the evening. Horizons cloudy, overhead clear during the morning and rain squalls at 16h 00m.
4	26 26 N	199 28	182	198	16	Moderate sea and fresh ENE breezes. Few drops of rain at 15h 24m. Cloudiness 4 to 5, overhead clear during the morning; cloudiness diminished to 3 by evening and to 2 by 24h 00m.
5	29 08 N	198 46	165	220	12	Moderate sea. Moderate to fresh ENE breezes. Cloudiness 3 to 5 during the morning, with the sky about half overcast in the afternoon and a few drops of rain at 13h 30m and at 16h 18m. The sky was partly cloudy in the evening.
6	31 42 N	199 00	154	214	13	Moderate sea during the day; smooth sea in the evening. Moderate to gentle E breezes in a.m. and gentle to light E breezes in p.m. The sky was more than half overcast all day.
7	32 46 N	199 16	64	324	8	Smooth sea with swells. Light E breezes and light E airs in a.m. and light NExE airs and light NE breezes in the afternoon and evening. Sky clear in early morning, cloudiness 3 to 4 during the day and squally near midnight. Started the engine at 11h 18m.
8	34 16 N	200 02	98	230	10	Smooth sea during the day with moderate sea in the evening. Light NE breezes and NE airs and gentle ExS breezes in the forenoon, with light to gentle SE breezes in the afternoon and moderate to fresh SW breezes in the evening. Sky cloudy most of the day with a short drizzle at 18h 42m. Stopped engine at 11h 48m.
9	34 05 N	203 07	153	290	10	Sea moderate and choppy. Fresh to strong SW breezes during the day, with fresh to gentle NW breezes in the evening. The sky was overcast and squally all morning with a short rain squall at 06h 12m. Sky overcast during the afternoon with a little rain at about 17h 00m.
10	33 35 N	205 31	123	233	10	Sea smooth during the early morning, swells during the day, and moderate sea in the late evening. Gentle NW breezes to NW airs during the day with light S airs to gentle S breezes in the first part of the evening and gentle to moderate SxW breezes during the latter part of the evening. Engine started at 09h 00m, stopped at 20h 12m.
11	33 39 N	208 20	141	236	8	Sea moderate in a.m. and choppy in p.m. Moderate to fresh SW breezes all day. The sky was partly cloudy in the forenoon and mostly overcast in the afternoon with a little rain at about 18h 00m
12	33 17 N	212 18	200	258	10	Sea choppy in a.m. and moderate in p.m. Strong to fresh SxW and SW breezes in a.m. with a moderate NW breeze in the first part of the afternoon; calm at 15h 00m. Gentle to moderate SW breezes during the rest of the day. The sky was overcast all day and there were occasional rains.
13	33 26 N	214 36	116	255	7	Moderate sea in a.m. and swells in p.m. Gentle to fresh NW breezes in a.m. with light NW, W, and WSW breezes in the afternoon and evening. The sky was overcast and squally in the morning, and partly cloudy for the rest of the day.
14	33 34 N	216 52	114	237	9	Moderate sea. Gentle and moderate SW breezes in a.m. with fresh SSW and SxW breezes in p.m. The sky was partly cloudy all day with a few drops of rain at 23h 30m.
15	31 48 N	219 15	161	330	18	Choppy sea. Fresh SW breezes in a.m. with breezes NW, NNW, NxE, and NExN, moderate to fresh during the rest of the day. The sky was partly cloudy in the a.m. and completely overcast in the afternoon and evening with rain from 12h 30m to 13h 00m and from 15h 30m to 16h 36m.
16	29 03 N	220 41	181	279	21	Sea moderate to choppy. Fresh NE breezes all day and light SW breezes in the evening. The sky was overcast and cloudy most of the day with a few drops of rain at 03h 30m and rain from 16h 30m to 17h 30m and a drizzle from 20h 30m to 21h 48m. Engine started at 18h 48m, stopped at 19h 42m, and started again at 20h 06m.
17	27 22 N	221 52	119	302	13	Moderate sea in the early morning and smooth sea the rest of the day. Light SSW and SxW breezes in a.m. with light S airs the first part of the afternoon and calms the rest of the day. The sky was mostly clear all day. Engine: stopped at 08h 00m and started again at 10h 42m.
18	26 01 N	222 54	98	313	7	Smooth sea all day. Calm in the early morning, variable light airs to light breezes from the SE quarter the rest of the morning and light ExS breezes in the afternoon with gentle ExS and ExN breezes in the evening. Engine stopped at 06h 36m.

Date	Noon Position Latitude	Noon Position Longitude east	Day's run	Current Dir.	Current Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Oct. 19	24 57 N	222 15	373	334	16	Moderate sea. Gentle ESE breezes in a.m. and gentle to moderate ENE breezes in the afternoon. The sky was almost wholly overcast during the early morning hours, with rain squalls and rain from 02h 06m to 02h 18m, from 03h 06m to 03h 12m, and from 06h 18m to 06h 42m. The sky partly cleared near midday but later became overcast. There was a drizzle from 15h 42m to 15h 48m and from 22h 42m to 22h 48m.
20	23 10 N	221 40	112	329	16	Moderate sea. Moderate ExS breezes most of the day. The sky was more than half overcast all day but the cloudiness decreased to 3 in the evening. There were frequent drizzles and rains in the early morning.
21	21 15 N	221 25	116	337	16	Moderate sea and gentle to moderate E breezes in a.m. and moderate breezes from the E, ExN, and ENE in the p.m. The cloudiness was about 8 all day.
22	18 18 N	221 59	180	306	21	Moderate sea in forenoon, choppy thereafter. Breezes: moderate to fresh from the E, ExN, ENE, and NExE. The sky was about half overcast most of the day.
23	16 11 N	222 55	138	306	29	Choppy and moderate sea. Moderate to fresh NExE breezes. The cloudiness was 10 in the early morning and the late evening with an average of 5 during the day.
24	13 34 N	223 19	159	296	24	Seas: choppy, moderate and broken. Breezes: moderate to fresh, ExN, ENE, and NE until 13h 00m with light N airs in the afternoon and light SxW breezes in the evening. The sky was almost wholly overcast all day with a drizzle from 00h 12m to 01h 54m, a few drops of rain at 02h 00m and more rain from 18h 18m to 18h 30m. Engine: started at 17h 06m, stopped at 21h 48m, and started again at 23h 12m.
25	12 39 N	222 28	74	188	1	Sea smooth to moderate. In the forenoon there were light breezes variable from the SW quarter and light E airs and calms during the rest of the day. The sky was overcast nearly all day with frequent rains and squalls all day. Engine: stopped at 08h 00m and started at 13h 42m.
26	11 19 N	221 21	104	109	8	Smooth sea. Light NW airs to light NW breezes during the day and calms all evening. Engine: stopped at 08h 00m and started again at 13h 00m.
27	10 05 N	220 17	97	70	16	Smooth sea with light E airs and calms all day. The sky was mostly clear all day but there were rains between 16h 00m and 18h 00m and squalls near 24h 00m. Engine: stopped at 08h 00m and started again at 12h 00m.
28	8 36 N	219 16	107	95	34	Smooth sea. Variable light airs and light breezes from the SE quarter in the a.m. with variable light to gentle breezes from the NE quarter the rest of the day. The sky was about half overcast all day. Engine stopped at 08h 12m.
29	7 44 N	218 38	64	92	30	Smooth sea the first part of the day and moderate thereafter. Variable light to gentle E breezes all day. The sky was about 0.5 overcast all day with a little rain at 02h 42m and at 06h 54m.
30	7 03 N	217 29	80	75	32	Sea smooth to moderate. Variable light to gentle breezes from the SE quarter all morning increasing to moderate and fresh breezes from the same quarter and changeable light breezes from nearly all quarters during the evening. The sky was partly cloudy in the morning and mostly overcast in the afternoon with rains in the evening and a heavy rain from 22h 00m to 23h 00m.
31	6 43 N	216 39	54	72	19	Smooth sea with light SW and SE airs and calms during the forenoon and variable light airs to gentle breezes from the SE quarter in the afternoon. The sky was more than half overcast all day with rain from 00h 00m to 01h 12m and rain from 12h 24m to 12h 48m. Engine: started at 01h 12m, stopped at 02h 12m, and started at 03h 12m, and stopped again at 19h 30m.
Nov. 1	5 46 N	215 20	97	28	15	Sea smooth in a.m. and moderate in p.m. Breezes light to moderate from SE, SExE, and SxE in the morning and the first part of the afternoon and moderate SSE and SExE breezes all evening. The sky was mostly overcast nearly all day; there was a drizzle from 04h 48m to 04h 54m and rain from 09h 12m to 09h 30m and from 12h 48m to 14h 30m. The sky was partly clear in the evening.
2	4 52 N	213 13	137	53	12	Moderate sea with moderate SExS breezes. The sky was completely overcast most of the day.
3	4 18 N	210 44	152	16	32	Moderate sea all day and smooth sea all evening. Moderate SSE and SxE breezes all morning, calm all afternoon and most of the evening with light SExS airs near midnight. The sky was nearly all overcast all day but was partly clear in the evening. Engine started at 16h 00m.

Date	Noon position: Latitude	Noon position: Longitude east	Day's run	Current: Dir.	Current: Am't.	Remarks
1929	° ′	° ′	miles	°	miles	
Nov. 4	3 02 N	210 12	82	13	13	Smooth sea in morning and moderate sea all evening. Light to gentle SExS breezes in a.m., and gentle to moderate SE breezes all afternoon and evening. The sky was partly overcast all day. Engine stopped at 08h 00m.
5	0 48 N	208 32	168	349	12	Moderate sea with moderate and fresh SExE and ESE breezes all day. The sky was mostly clear all day. Crossed the equator at about 18h 30m.
6	1 49 S	207 36	167	356	21	Moderate sea in early morning and choppy the rest of the day. Fresh ExS breezes in a.m. and fresh ExN and ENE breezes the rest of the day. The sky was partly overcast all day.
7	4 52 S	206 36	193	315	19	Moderate sea with moderate NE breezes. The sky was mostly clear in the morning and evening; but was partly cloudy near midday.
8	6 38 S	204 55	145	31	5	Moderate sea and moderate NE, NExE, E, and ENE breezes in the afternoon. The sky was mostly clear all day.
9	8 05 S	203 05	140	20	16	Moderate and gentle ENE, NNE, and NE breezes. The sky was partly cloudy all day.
10	9 00 S	201 56	87	116	8	Moderate sea in forenoon and smooth sea in the afternoon with gentle NE breezes most of the day. The sky was partly clear. Sighted Penrhyn Island at 05h 12m. At Penrhyn Island from 09h 48m to 18h 00m. Engine for short intervals 07h 30m to 18h 00m. Engine: started at 18h 12m and stopped at 19h 54m.
11	9 24 S	200 58	62	58	15	Smooth sea with gentle NE, N, ENE, and ExN breezes. The sky was partly clear most of the day.
12	10 24 S	198 56	135	22	15	Moderate sea in the morning and in the evening with smooth sea near midday, with moderate to gentle ExN, NE, and NNE breezes. The sky was mostly clear all day. Arrived at Tauhunu village Manahiki Island at 12h 24m and left the island at 17h 42m. Engine at intervals 12h 00m to 18h 00m.
13	10 58 S	198 02	63	126	13	Moderate sea most all day with smooth sea in early morning and late evening. Light to gentle NExE breezes in the forenoon and moderate to light NNE breezes in the afternoon. The sky was about 0.5 overcast except near 08h 00m when it was completely overcast, with rain from 06h 12m to 07h 42m and from 09h 00m to 09h 12m.
14	11 35 S	196 36	92	95	13	Smooth sea with light NNE airs in the forenoon and calms in the afternoon. The sky was mostly clear. Started the engine at 08h 42m.
15	12 03 S	195 03	95	65	17	Smooth sea. Light S airs and light E breezes in the forenoon and light NE, SE, and S airs in the afternoon. The sky was mostly clear all day. Engine: stopped at 08h 00m and started again at 13h 48m.
16	12 50 S	193 01	128	30	10	Smooth sea with light SSE breezes and light S airs in the forenoon and calms most of the afternoon. The sky was almost wholly clear all day.
17	13 37 S	191 37	95	109	14	Smooth sea with calms and light SW, W, and WxN airs. The sky was mostly clear all day. Engine: stopped at 08h 00m and started again at 11h 48m.
18	14 13 S	189 34	124 (17)	56	13	Smooth sea with calms and light WNW airs to gentle WNW and NW breezes. The sky was mostly clear. Ran 17 miles from noon position to moorings in Pago Pago harbor at 15h 00m.

Note: Left Pago Pago for Apia about 15h 00m, Nov. 27, arriving at Apia about 08h 00m, Nov. 28. Under engine power all the way with head winds on first leaving Pago Pago, 80 miles.